Accounts of Bat Species Found in Montana

Prepared for:
Montana Department of Environmental Quality
Air, Energy, & Mining Division, Coal Section

Prepared by:
Dan Bachen, Alexis McEwan, Braden Burkholder, Scott Blum, and Bryce Maxell
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MONTANA Natural Heritage Program

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Introduction

Montana has 15 species of bat found within its borders. This diverse group includes seven genera, with the Myotis genus having the most species. Bat diversity is high across the state with diversity increasing from the short grass prairies to western and southern regions. While much of the life history of these species is still unknown, research over the last few decades to determine species presence, roost habits, and activity patterns has increased out knowledge exponentially. We now have more data on where species roost across the year, when they are active, seasonal trends in this activity, when breeding occurs, and what future and ongoing threats exist to these species. This report is the latest in a series of reports summarizing, species identification activity and life history (Bachen et al. 2018) and use of roost structures (Bachen et al. 2019) which are derived from work conducted by the Montana Natural Heritage Program, Montana Fish Wildlife and Parks, the United States Forest Service, the Bureau of Land Management, and many other agencies and private entities working on bats in Montana.

This report seeks to aggregate information on individual species to promote a better understanding of the life history and phenology of each species and through this help land managers conserve these species. Within Montana most information about bats has been publish as project reports and relatively few journal publications exist. When data specific to Montana could not be found, we utilized data from other areas where a species was better studied. Even when this additional information is incorporated, large gaps in the understanding of the biology and ecology of many species remain. It is our hope that these accounts not only increase the reader's knowledge of the species, but also identify gaps in our current knowledge and promote future research to address these needs.

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Pallid Bat (*Antrozous pallidus*)

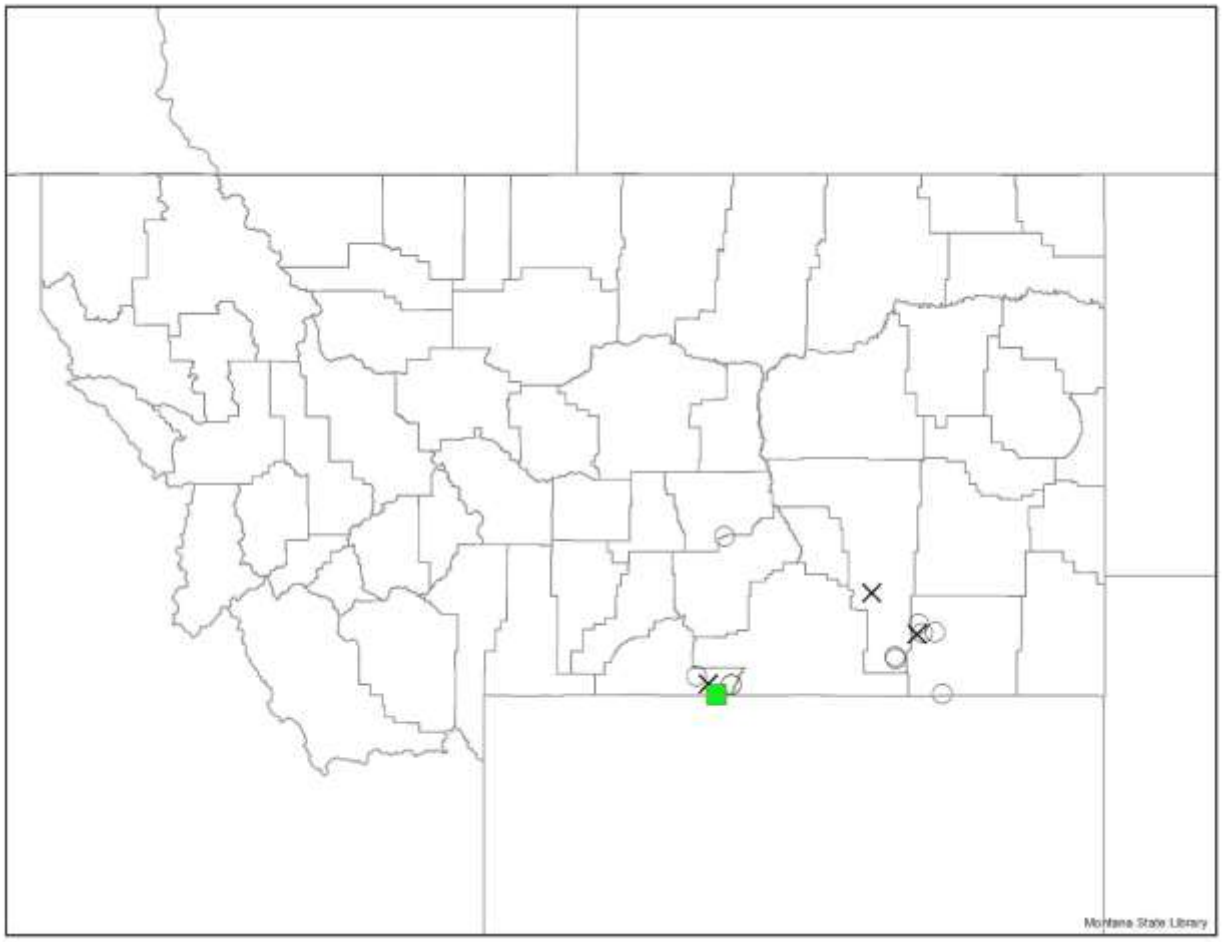

Figure 1. Observations of Pallid Bat in Montana. Green squares represent voucher specimens, green triangles tissue or guano samples that have been genetically verified. Open circles represent in-hand identifications from mist net captures, roost surveys or incidental encounters. "X"s are hand verified call sequences recorded with acoustic detector/ recorder units.

General Description

Pallid bats are a relatively large bat adapted to dry forests and deserts of western North America. In Montana they are found in the South Central region of the state in dry shrublands and forests dominated by Ponderosa Pine and Juniper in proximity to rock outcrops. These pale bats have large ears and should not be readily confused with any other species. Currently they are among the most poorly documented of all bat species in the state with 22 observations and 3 roosts documented.

Diagnostic Characteristics

Pallid Bat is among our largest species of bat in Montana at least in size if not weight. Pelage and membranes are pale brown to blond and the ears are large. Although the species is readily identified by its general appearance and size, the presence of "pig-like" nostrils and ears that do not meet on top of the animals head help separate it from other light colored bats with large ears (e.g. Townsend's Big-eared Bat).

The calcar lacks a keel. The total length is 92 to 135 millimeters, tail length is 35 to 53 millimeters, hind foot length is 11 to 16 millimeters, ear length is 21 to 37 millimeters, forearm length is 45 to 60 millimeters, and skull length is 18.6 to 24 millimeters. Females tend to be larger than males (mass 13.6 to 24.1 grams in males, 13.9 to 28.0 grams in females) (Hermanson and O'Shea 1983). The skull has 28 teeth (dental formula: I 1/2, C 1/1, P 1/2, M 3/3) (Nagorsen and Brigham 1993).

The species is readily identified in-hand, and both roost surveys and mist netting are effective survey tools for detection. Visual encounter surveys of rock outcrops where the observer looks under rocks and in cracks and crevices with a high-powered light have been effective as documenting this species, although detection rates are low. Mist-net captures at drinking sites have been the most effective survey technique. The species is typically captured at moderately sized reservoirs and ponds or smaller water sources that have adequate flyways to allow approach and departure of this large bat.

Detection using acoustic methods is possible. Three long-term detector stations have recorded Pallid Bat call sequences, but confidence in species identification is typically low and high volumes of calls are needed to determine presence.

Distribution

Although the core range of the Pallid Bat in Montana has been characterized, the species may be more broadly distributed than currently recognized. The species has been documented in xeric environments from the Pryor Mountains north to the Bull Mountains and east to the Ashland District of the Custer Gallatin National Forest. These areas are primarily Sagebrush Steppe intermixed with Ponderosa pine or Juniper forest with abundant rock outcrops.

Pallid bats have only been observed at lower elevations but are found up to 5,000 ft in the Bull Mountains.

Migration

Whether Pallid Bats migrate to areas within or outside of Montana is currently unknown. The species has not been observed between October and April, but observations are sparse across space and time within Montana so whether this absence represents hibernation or migration is uncertain. Most records are from summer (Shryer and Flath 1980, Worthington 1991, P. Hendricks and J. Carlson personal observation). Little information is available outside of Montana (Barbour and Davis 1969, Schmidly 1991). Distances of fall movements are not known, but Pallid Bats seem to be somewhat sedentary and probably do not move far between summer and winter roosts (Barbour and Davis 1969).

Habitat

Habitat on the southern face of the Pryor Mountains is Utah juniper (*Juniperus osteosperma*) and black sagebrush (*Artemisia nova*) with significant areas of sparse vegetation. In the Bull Mountains the species has been documented in an area dominated by ponderosa pine (*Pinus ponderosa*) and big sagebrush (*Artemisia tridentata*). Within the Ashland District of the Custer-Gallatin National Forest, animals have been captured or observed in Xeric Ponderosa Pine Forest with open areas dominated by Sagebrush. These habitats are similar to those where the species has been detected in Rosebud County. Across all areas, outcrops of sandstone, limestone, and other rock types are found in immediate vicinity or within short flying distance. Several day roosts were discovered during surveys of south facing sandstone outcrops for reptiles in southeast Montana. One individual was found under a plate-like sandstone rock,

while another was found roosting in a crack within a large sandstone bolder. This species has not yet been detected at caves or abandoned mines in Montana. Most observations have been at or near water sources such as spring-fed pools or stock reservoirs (Shryer and Flath 1980). However, habitat use in Montana by this species remains poorly known and unstudied and both habitat use and distribution may be broader than currently documented.

At other locations, Pallid Bats have been found in arid deserts, juniper woodlands, sagebrush shrub-steppe, and grasslands, often with rocky outcrops and water nearby. They are less abundant in evergreen and mixed conifer woodlands, but in British Columbia are found in ponderosa pine forest near cliffs (Nagorsen and Brigham 1993). They typically roost in rock crevices or buildings, less often in caves, tree hollows, under bridges, and in abandoned mines (Hermanson and O'Shea 1983, Verts and Carraway 1998); night roosts often are in caves in Oklahoma (Caire et al. 1989). Four summer roosts in Wyoming were in rock shelters (1), caves (2), and mines (1) (Priday and Luce 1997). Day and night roosts are usually distinct. In Oregon, night roosts were in buildings, under rock overhangs, and under bridges; Pallid Bats generally were faithful to particular night roosts both within and between years (Lewis 1994). Night roosts in British Columbia were often in cavities in ponderosa pine (Nagorsen and Brigham 1993). Day roosts include rock piles, tree hollows, and rock crevices. Pallid Bats found in caves or mines usually use crevices within these places (Hermanson and O'Shea 1983, Caire et al. 1989). Maternity colonies are often located in horizontal crevices in rock outcrops and man-made structures, where temperatures are a fairly constant 30 degrees.

Food Habits

The primary diet is arthropods, which are often captured on the ground after an aerial search. They also capture some food (large insects) in flight, within a few meters of ground vegetation. Food items include flightless arthropods, such as scorpions, solpugids, centipedes, Jerusalem crickets, grasshoppers, moths, and beetles; they may eat small vertebrates, such as lizards and mice (O'Shea and Vaughan 1977, Hermanson and O'Shea 1983, Johnston and Fenton 2001). Pallid Bats also visit bat-adapted plants (e.g., Agave), and may be seeking insects (Herrera et al. 1993). In the southern portions of its range it appears to be a facultative nectivore and readily forages on the nectar and fruit of cacti (Frick et al. 2009). Foraging often occurs at 0.5 to 2.5 meters above ground. The diet and foraging behavior in Montana have not been reported or studied.

Ecology

Pallid bats have been observed as early as April and as late as October. Similarly Pallid Bats are active in Arizona from early April through October; Oregon records extend from mid-April to late September (O'Shea and Vaughan 1977, Verts and Carraway 1998). Relative to other bat species, they emerge from roosts relatively late in the day (45 minutes or more after sunset), which may protect them from some aerial predators. They are a gregarious species. They usually form clusters in diurnal roosts, and may also gather in night roosts that are frequently near, but separate from, day roosts (Lewis 1994). Brazilian Free-tailed Bat (*Tadarida brasiliensis*) and Yuma Myotis (*Myotis yumanensis*) may roost among Pallid Bats in some regions (Hermanson and O'Shea 1983). Pallid Bats are pollinators of columnar cacti and agaves in the Sonoran and Chihuahuan deserts, although they may be visiting the flowers to capture insects (Herrera et al. 1993). There appear to be no estimates of abundance for any locality where this bat occurs. The ecology and predators in Montana have not been studied or reported.

Reproduction

Capture of males, lactating females, and juveniles indicates reproduction is occurring in Montana (Worthington 1991, Foresman 2012), although timing of reproductive events is poorly defined. Lactating females have been captured in early August (P. Hendricks and J. Carlson personal observation), and juveniles in August and early September.

Based upon data gathered from other locations, copulation usually occurs in October to December. Maternity colonies are situated where temperatures are a fairly constant 30 degrees. Fertilization is delayed until spring. In the U.S., young are born in late May to early June in California, mostly late June in Kansas, and probably early May to mid-June in Texas (Schmidly 1991). The normal litter size is 2, but sometimes only one young is born. Young begin to fly at 6 weeks and are weaned in 6 to 8 weeks (Hermanson and O'Shea 1983). In Oregon, reproductive success was reduced in a year with low spring temperatures, and roost-site switching by pregnant and lactating females was correlated to ectoparasite loads (Lewis 1993, 1996). Maternity colonies usually are small, but may include up to 200 adults, including a few adult males (O'Shea and Vaughan 1977, Hermanson and O'Shea 1983, Lewis 1996).

Management

Right now Pallid Bat is not managed in Montana. It is currently a Species of conservation concern, primarily due to limited information and perceived rarity. *Pseudogymnoascus destructans* (*Pd*) has not been detected on Pallid Bats nor have individuals been found with symptomatic White-Nose Syndrome (WNS, White-Nose Syndrome Response Team 2020). The species distribution is on the leading edge of the disease as it progresses westward, so it is difficult to say whether it is susceptible to WNS or carries Pd. Wind energy does not appear to be a concern for the species as mortalities have not yet been documented (AWII 2018).

Perhaps the most meaningful impacts managers can have on this species in Montana are through conservation of water in dry areas. Pallid bats are relatively large animals and require areas of open water with adequate flyways to drink. Managers should ensure water is present in large stock tanks and reservoirs throughout the spring, summer, and early fall and remove encroaching vegetation that may impede approach or departure from waterbodies.

Townsend's Big-eared Bat (*Corynorhinus townsendii*)

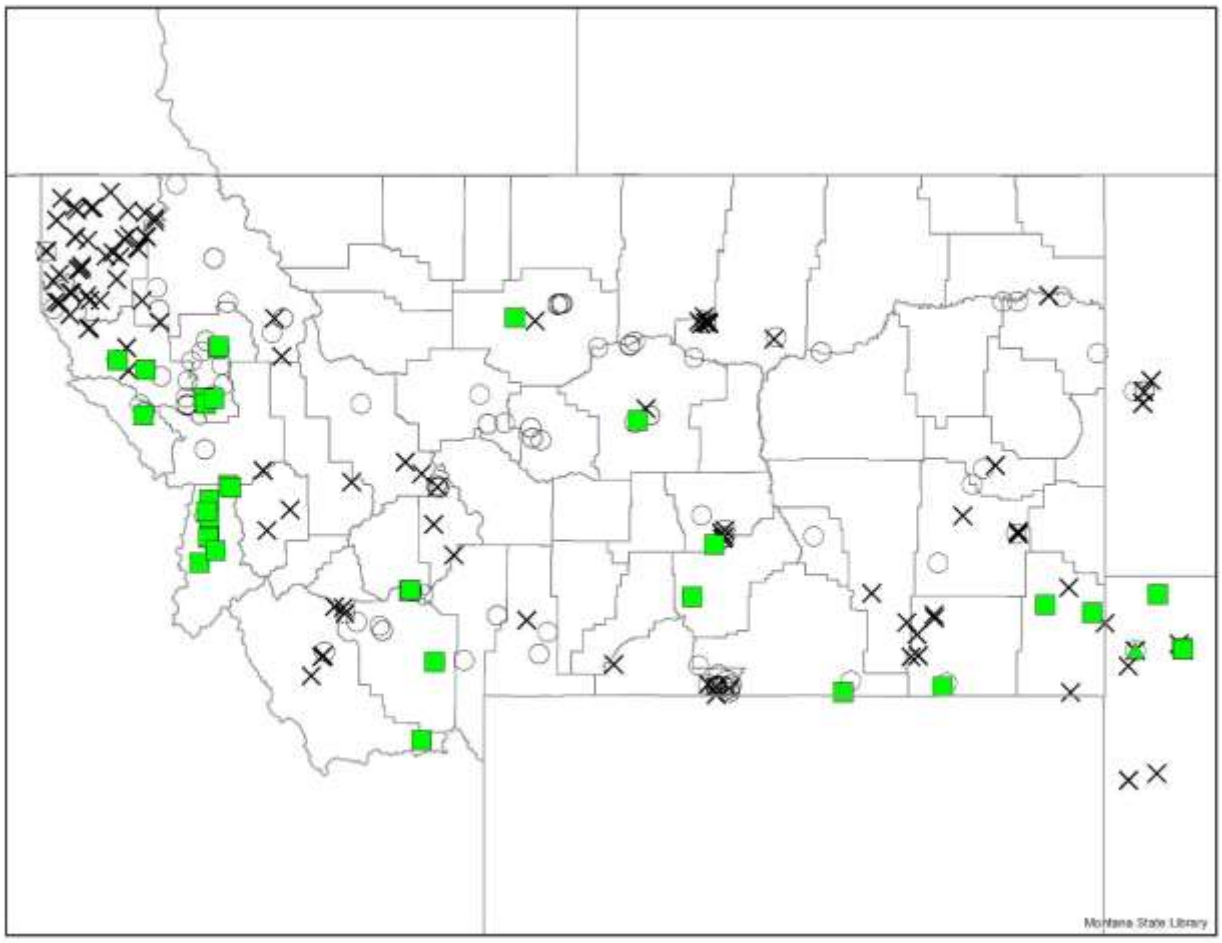

Figure 2. Observations of Townsend's Big-eared Bat in Montana. Green squares represent voucher specimens, green triangles tissue or guano samples that have been genetically verified. Open circles represent in-hand identifications from mist net captures, roost surveys or incidental encounters. "X"s are hand verified call sequences recorded with acoustic detector/ recorder units.

General Description

Townsend's Big-eared Bat is a moderately sized bat found throughout the state where suitable habitat exists, primarily caves, mines, and badlands. As the common name suggests, the species has large ears compared to its overall size. Although it never appear to be common in any portion of the state, it's distribution is widespread and is among the most commonly observed species during cave surveys. To date animals have been observed at 441 sites in all areas accept the short-grass prairies of northcentral and northeast Montana.

Diagnostic Characteristics

Townsend's Big-eared Bat is a readily identified in-hand when found at roosts or captured in mist nets and while roosting and can also be detected using acoustics and through genetic methods (Bachen et al. 2018). The species might be confused with other long-eared species such as Pallid Bat, but can be separated by ears which meet in the interior margin, prominent "lumps" on the nose, and general appearance. The species is infrequently captured in mist nets. Nets set over water can be used, but

captures are typically rare. The species is more frequently captured by placing nets within tight flyways in high clutter environments such as tall brush and densely forested areas. Surveys of caves and mines are an efficient way to detect the species as it is one of the most commonly encountered species within these features, particularly in the winter. Acoustic methods are effective and call sequences distinct, but echolocation is typically much quieter than other bat species and microphones must be placed close to roosts or foraging areas to ensure any individuals in the area are recorded.

Distribution

Townsend's Big-eared Bat has been documented across Montana in areas with suitable foraging and roosting habitats. These bats forage in high clutter environments such as tall brush and forest understory. Active season roosts include caves, mines, erosion cavities, and structures like buildings and bridges. As such only the short-grass prairies of northcentral and northeast Montana appear to be uninhabited by this species.

Migration

Little information on movement is available for this species. Townsend's Big-eared Bat is present year-round in Montana, with summer or winter records from several localities (Hoffmann et al. 1969, Swenson and Shanks 1979, Hendricks 2000, Hendricks et al. 2000, Hendricks and Kampwerth 2001), but movements of individuals between active season roosts and hibernacula have not been reported or studied. The species has been consistently detected in several caves in western and central Montana in both the active and hibernation seasons. While not conclusive, anecdotally this supports the hypothesis that seasonal movement is limited.

Habitat

Habitat use in Montana has not been evaluated in detail, but seems to be similar to other localities in the western United States. Habitats in the vicinity of roosts include Douglas-fir (*Pseudotsuga menziesii*) and Lodgepole Pine (*Pinus contorta*) forests, ponderosa pine (*P. ponderosa*) woodlands, Utah juniper (*Juniperus osteosperma*)-sagebrush (*Artemisia* spp.) scrub, and cottonwood (*Populus* spp.) bottomland. Animals have been captured in mist nets placed across flyways in deciduous and coniferous forests and tall brushy areas along river drainages in eastern Montana (Bachen 2019).

Roost Habitat

Of all of Montana's bat species, Townsend's Big-eared Bat is the most closely associated with caves, mines, and other similar features such as talus caves and erosion cavities found in badlands and river breaks. Caves and abandoned mines are used for maternity roosts and hibernacula (Worthington 1991, Hendricks et al. 1996, Hendricks 2000, Hendricks et al. 2000, Foresman 2012, Hendricks and Kampwerth 2001); use of buildings in late summer has also been reported (Swenson and Shanks 1979). In hibernacula, ambient temperatures ranged from -1.0 to 8.0 degrees (30 to 46 when torpid Townsend's Big-eared Bats were present) (Hendricks and Kampwerth 2001). Temperatures at maternity roosts are poorly documented; the temperature was 12 degrees (54 in mid-July near a colony in an abandoned mine in Lake County), and 18 degrees (66 in August near a colony in a large and relatively open cave chamber in Lewis and Clark County). Most caves and mines in Montana appear to be too cool in summer for use as maternity roosts.

Food Habits

Townsend's Big-eared Bat feeds on various nocturnal flying insects near the foliage of trees and shrubs, but appears to specialize primarily on small moths (Kunz and Martin 1982); other insects in the diet include lacewings, beetles, true flies, and wasps. There are reports of gleaning insects from foliage, but most are captured in the air, often near foliage. In a California study, individuals hunted primarily around the perimeter of trees, usually 10 to 30 meters off the ground, between mid-canopy and near the top of the canopy (Fellers and Pierson 2002). The diet and foraging behavior of Townsend's Big-eared Bat in Montana have not been reported or studied.

Ecology

Females form maternity colonies during the spring and summer. Colonies are typically composed of 20 to 180 females, each giving birth to one pup after a gestation period of 55 to 100 days (Pearson et al. 1952, Genter personal observation). Pups are able to fly in 3 weeks and are weaned at 6 weeks. Both sexes congregate at cooler caverns (called swarming sites) in late summer/early fall.

Townsend's Big-eared Bat emerges from day roosts in coastal California and central Oregon within an hour after sunset (Dobkin et al. 1995, Fellers and Pierson 2002); limited information from Montana indicates a similar emergence time (P. Hendricks and J. Carlson personal observation). In Oregon, individuals moved up to 24 kilometers from hibernacula to foraging areas (Dobkin et al. 1995). In California, foraging individuals traveled less than 10.5 kilometers from primary day roosts and tended to forage in the same areas each night. The mean center of activity for females was 3.2 kilometers from the roost, and 1.3 kilometers for males; 41 to 88% of tagged bats returned to their roost each night. Individual bats used nine alternate roosts (Fellers and Pierson 2002).

Townsend's Big-eared Bat tends to hibernate singly, but does occur in clusters during winter in some areas (Schmidly 1991). It tends not to associate closely in day roosts and hibernacula with other species of bats, although individuals of other species may be present elsewhere in the roost (Handley 1959, Kunz and Martin 1982, Genter 1986, Choate and Anderson 1997, Kuenzi et al. 1999). In Montana, Townsend's Big-eared Bat has been found at summer and winter roosts in the presence of other bat species (Swenson and Shanks 1979, Worthington 1991, Hendricks et al. 2000, Hendricks and Kampwerth 2001), although it usually hibernates in the open and alone, rather than in clusters or wedged in cracks.

Crude population density in Oklahoma was estimated at one bat per hectare (Humphrey and Kunz 1976, Kunz and Martin 1982), about 3 to 4 times greater than that reported in California (Pearson et al. 1952). Natality rates for colonies of adult females typically exceed 90%, but may be as low as 35% (Kunz and Martin 1982, Fellers 2000); pre-weaning post-natal mortality of adults generally is 4 to 5%. Adult survivorship is relatively high (about 70 to 80% in females in California). Regional population increases in California may be dependent on the establishment of new nursery colonies (Pearson et al. 1952), since colony size has been reported to remain static year after year. Predation has been suggested as the primary limiting factor in Kansas and Oklahoma (Handley 1959), although lack of suitable roosting habitat seems more likely to limit population size in this region (Humphrey and Kunz 1976). Predators of Townsend's Big-eared Bat are poorly documented, but include the Black Rat (*Rattus rattus*) and Eastern Woodrat (*Neotoma floridana*, Clark et al. 1990, Fellers 2000), as well as the Black Ratsnake (*Pantherophis obsoletus*), Spotted Skunk (*Spilogale spp*.), Domestic Cat (*Felis catus*), and Ringtail (*Bassariscus astutus*, Pierson et al. 1999); predators can significantly depress reproductive success in

some maternity colonies. No demographic data or estimates of population size are available for any population in Montana, nor have any predators been documented.

Reproduction

No published studies are available on the reproductive biology of this species in Montana, and other documentation is very limited. Only five maternity colonies are known in Montana, with an estimated size in recent years of 25 to 100 adult females each. Lone adult females captured in early August in the Pryor Mountains were non-lactating (P. Hendricks and J. Carlson personal observation); flying juveniles appear in the same region sometime between late June and early September (Worthington 1991).

Based upon studies in other areas of the species' range mating begins in autumn and continues into winter. Ovulation and fertilization are delayed until late winter/early spring. Gestation lasts 2.0 to 3.5 months. A single young is born during a five week period, beginning mainly in late May in California, June in west Texas, and the second week of July in Washington (Pearson et al. 1952, Easterla 1973, Kunz and Martin 1982). Young can fly at 2.5 to 3.0 weeks, and are weaned by 6 weeks. In central California, summer colonies start to break up in August when the older young are just over 3 months old. Females become sexually mature their first summer; males are not sexually active until their second year. Young fly at 1 month of age and are weaned at 2 months. Most adult females breed every year. Maternity colonies are often smaller than 100 adult females, but up to 550 adult females are present in some (Easterla 1973, Humphrey and Kunz 1976, Pierson et al. 1991, Szewczak et al. 1998, Fellers 2000, Sherwin et al. 2000, Fellers and Pierson 2002). Males roost separately (apparently solitary) during this time. Maximum longevity is estimated to be about 16 to 17 years (Kunz and Martin 1982).

Management

Currently in Montana, Townsend’s Big-eared Bat is considered a Species of Conservation Concern. Although Pd has been detected on some individuals, WNS impacts are not a concern as individuals with symptomatic WNS have not been found (White-Nose Syndrome Response Team 2020). Similarly, mortality at wind turbines has not been documented (AWWI 2018). The largest threat to the species is loss of roost habitat due to the collapse and closure of mine adits and disturbance of roosts. In eastern Montana, numerous abandoned coal mines have been completely closed in recent decades, several of which were used as hibernacula; these mines are no longer accessible to bats. Abandoned mine reclamation has also been underway in western Montana during the same time. During the last decade, mine surveys prior to closure have been undertaken by land management agencies to determine the potential of abandoned mines as bat habitat. In some cases bat-friendly gates were installed at known Townsend's Big-eared Bat roosts, and the roosts have continued to be used after gate installation (Hendricks 1999, Hendricks and Kampwerth 2001).Disturbance within caves is likely less of an issue as few are used during the active season and most caves are inaccessible due to snow and unvisited in the winter. The maternity colony at Lewis and Clark Caverns has persisted for over a century, even though it is exposed daily to tour groups. Some caves in the Pryor Mountains and Little Rocky Mountains with documented use by Townsend's Big-eared Bat are protected with bat-friendly gates (Worthington 1991, Hendricks et al. 2000).

Abandoned mines should be surveyed for Townsend's Big-eared Bats or other bat species prior to any reclamation activity. Surveys should follow protocols in the conservation assessment and conservation strategy (Pierson et al. 1999). Installation of bat-friendly gates should be considered as a protective

measure for all Townsend's Big-eared Bat roosts. Other land management activity (cave management, pesticide spraying, timber harvest, other vegetation conversion) at or near known roosts should also be conducted according to the best management practices outlined in the conservation assessment and strategy. Maternity roosts and hibernacula should be routinely monitored to establish population trends across the state.

Big Brown Bat (*Eptesicus fuscus*)

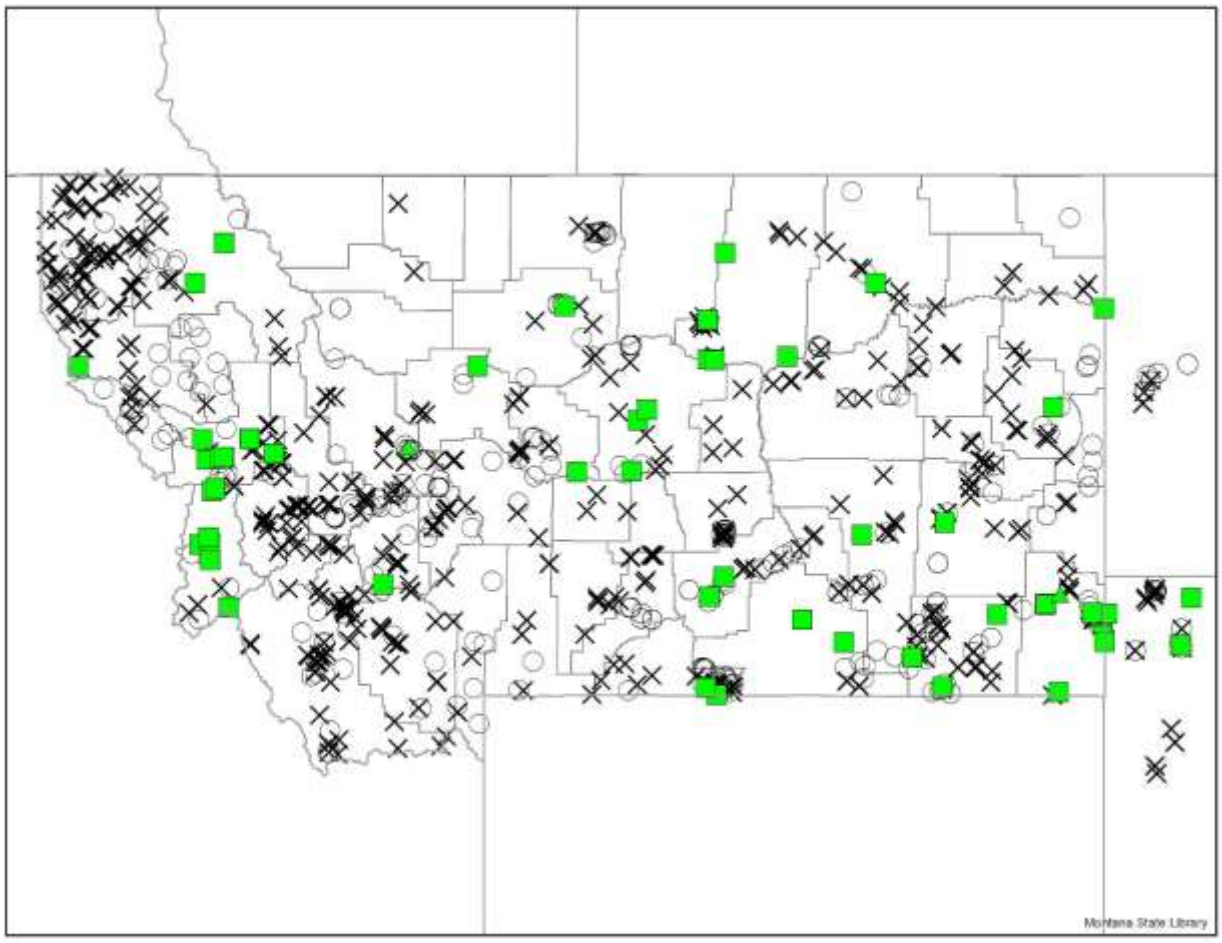

Figure 3.Observations of Big Brown Bat in Montana. Green squares represent voucher specimens, green triangles tissue or guano samples that have been genetically verified. Open circles represent in-hand identifications from mist net captures, roost surveys or incidental encounters. "X"s are hand verified call sequences recorded with acoustic detector/ recorder units.

General Description

Big Brown Bat is among the more common species found in Montana. As the common name suggests, this is a relatively large species with dark brown to blond fur. Like the Little Brown Myotis (*M. lucifigus*), this species readily exploits man-made structures as roosts which make it among the more commonly encountered species in Montana. Big Brown Bats are found state-wide, and are most common where suitable roost structures exist such as buildings and rock outcrops. Across the state the species has been observed at 1,251 locations. Although this is significantly less that several other species, Big Brown Bat is more difficult to identify using acoustics which decreases the number of observations.

Diagnostic Characteristics

Big Brown Bats superficially resemble *Myotis* bats found in Montana, but can easily be distinguished by size. Even juvenile Big Brown Bats are larger than almost all *Myotis* except for exceptionally large Fringed Myotis (*M. thysanodes*, Bachen et al. 2018). Adult Big Brown Bats typically have dark brown membranes, and uniform pelage that varies from dark brown to blond. Adults typically have forearm

lengths between 43 and 49 mm and weigh between 14 and 25 gr. Ears are relatively short and range from 11 to 15 mm. Forearm and weight should be used to separate this species from all Myotis. Other larger species of bats should be differentiated by general appearance. Some such as the Hoary Bat (*Lasiurus cinereus*) can be differentiated by pillage pattern. Bats with uniform colored fur such as the Pallid Bat (*Antrozous pallidus*) and Townsend's Big-eared Bat (*Corynorhinus townsendii*) have much longer ears.

Distribution

Big Brown Bat is found state-wide. However, the species is much less common across the grasslands of north central Montana likely due to lower roost densities.

Migration

Migration of Big Brown Bat has not been studied in Montana. Elsewhere movement of up to 80 km between summer and winter roosts have been documented (Mills et al. 1975). Few hibernaculum have been documented in the state (Bachen et al. 2019), but the species is known to use rock crevices in to overwinter in Alberta (Lausen and Barclay 2006), and may do so in parts of Montana as well (Bachen et al. 2020a). The species is also active during the winter across much of the state (Bachen et al. 2018), which may indicate that suitable overwintering sites are relatively common and if migration occurs, it is local rather than regional or continental.

Habitat

Big Brown Bat is a generalist species and is found across Montana in a diversity of ecosystems including forests, shrublands, and grasslands. The only limiting factor appears to be suitable roost features, but given that the species roosts in trees, man-made structures, and rock outcrops (Bachen et al. 2019) roosts are rarely limiting in most areas.

Roost Habitat

During the active season the species has been found using cracks and crevices in rock outcrops, man-made structures such as bridges and buildings, caves, and trees. Maternity colonies in Montana have been found in buildings, bridges, and snags (Swenson and Shanks 1979, Bachen et al. 2019). Winter hibernaculum are poorly documented for this species. Few individuals have been found using caves (Bachen et al. 2019). In southeast Montana a south-facing rock outcrop was associated with activity across the winter, but roosting animals could not be directly observed (Bachen et al. 2020a). In badlands similar to many areas of eastern Montanan, the species is known to use rock crevices and erosion cavities (Lausen and Barclay 2006).

Food Habits

Big Brown Bat consumes a diversity of insect types and species. Stomach contents analysis of 29 specimens from Carter County yielded a variety of insects including: Cleoptera, Diptera, Hemiptera, Lepidoptera, Homoptera, Hymenoptera, Neuroptera, Odoncata, and Trichoptera (Jones et al. 1973). Across the species range Coleoptera are significant portion of this species diet (Kurta and Baker 1990) and Lepidoptera compose a greater proportion of diet in western North America than eastern North America (Moosman et al. 2012).

Ecology

In Montana activity decreases in October and animals likely hibernate from late October through March or April. Low levels of winter activity are associated with this species, although the purpose of these flights during cold weather are not known. Breeding occurs in the fall or winter and females likely give birth to a single pup (Kurta and Baker 1990), although this has not been studied in Montana specifically. Based on capture data young are born in mid-June with the first flighted young observed in mid- July (Bachen et al. 2017). Longevity has not been studied in Montana specifically, but the species has been observed to live up to 19 years in the wild (Paradiso and Greenhall 1967).

Management

Threats to this species are likely to operate on the local and regional scales. Big Brown Bats are impacted by White-Nose Syndrome (White-Nose Syndrome Response Team 2020). Further study of impacts in Montana will be required to determine if this disease will drive significant declines in Montana. Mortalities of this species have not been documented at wind energy sites in Montana (Poulton and Erickson 2010, Linnell and Smucker 2019), but the species is occasionally killed in other areas of the country (AWWI 2018). In Montana roost destruction and disturbance is of great concern given the species use of man-made structures. In addition to impacts on local colonies due to intentional or unintentional removal, in at least one instance a colony was subject to poisoning through the application of DDT (Buchwitz et al. 2018).

Management of the species at the local scale should focus on education about best practices for colony removal, for example conducting work or sealing roosts during the winter to avoid destruction of maternity colonies and pup mortality. Continued monitoring of Big Brown Bat Populations should also be conducted to quantify impacts of WNS.

Spotted Bat (*Euderma maculatum*)

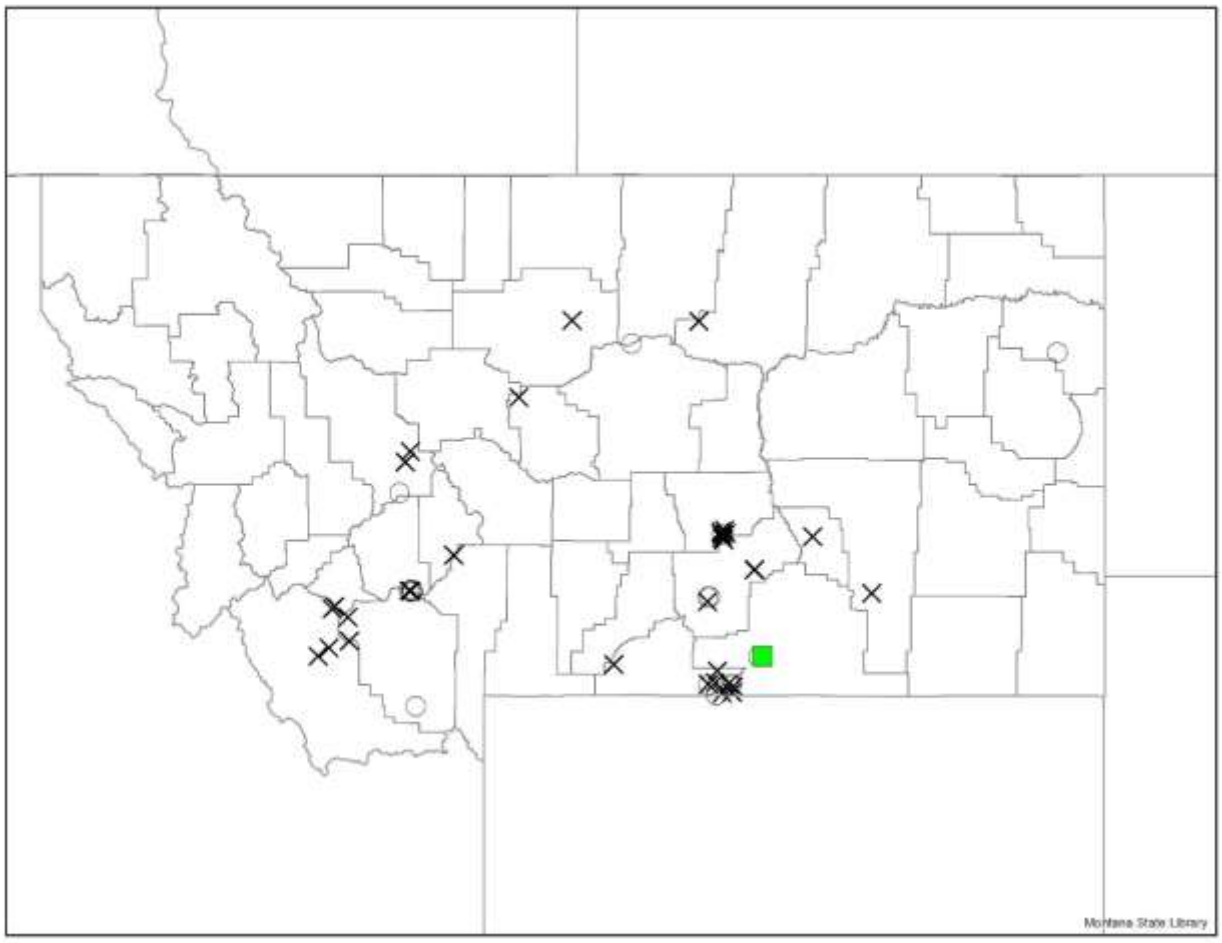

Figure 4. Observations of Spotted Bat in Montana. Green squares represent voucher specimens, green triangles tissue or guano samples that have been genetically verified. Open circles represent in-hand identifications from mist net captures, roost surveys or incidental encounters. "X"s are hand verified call sequences recorded with acoustic detector/ recorder units.

General Description

Spotted bat is one of the most striking bats found in Montana if not North America. Its large ears, black-and-white fur, and large size should make it unmistakable to any observer. Furthermore, it is the only species found in the state that echolocates at frequencies audible to humans. Observations of this species are rare and it appears to occur at low densities across much of central and eastern Montana. To date, only 182 observations exist and most are recordings of call sequences.

Diagnostic Characteristics

In-hand the Spotted Bat is unlike any other bat found in our region and should not be easily confused with any other bat species. It is the only species with black and white patterning on the fur. Spotted Bats have huge pink ears (37 to 50 millimeters long), the dorsum is blackish with a large white spot on each shoulder and on the rump, and white patches at the posterior base of each ear. Total length is 107 to 115 millimeters, forearm length is 48 to 51 millimeters, and weight is 16 to 20 grams. The greatest

length of the skull is 18.4 to 19.0 millimeters (small sample). The supraorbital region of the skull is sharply ridged, but a median sagittal crest is absent; 34 teeth are present (Watkins 1977). The newborn young lack any indication of having the adult color pattern (Van Zyll de Jong 1985). Four hours after birth, a male weighed 4 grams and measured 59 millimeters in length; tail length was 20 millimeters, hind foot 11 millimeters, ear 12 millimeters, and forearm 21 millimeters.

Spotted bats are difficult to capture but are well suited to acoustic detection methods. The species produces loud and unique echolocation calls well suited to acoustic detection methods (Bachen et al. 2018). It is the only species in Montana that has calls within the frequency range of typical human hearing without special equipment. However, care should be taken not to confuse social calls made by other species with search phase calls. Automated detector recorders can also record the species, but care should be taken when setting up the units to ensure low calls are not removed by the unit's filters.

Mist netting and roost surveys have been much less successful for the species in Montana. Only in one area of the Pryor Mountains has the species been captured with mist nets at either a flyway or water source. As the species is thought to roost within larger cliffs, roost surveys are not practical. In Montana the species has been infrequently observed within or near buildings, and searching buildings near large cliffs has been suggested as a viable survey technique (Sherwin and Gannon 2005).

Distribution

The western and northern boarders of the known range for Spotted Bat in Montana are formed by the Missouri River to the north and the Beaverhead River and its tributaries to the west. Within this general range, the species is found at specific sites usually near rugged river valleys and mountains.

Migration

Migration of Spotted Bat has not been studied in Montana. The species has been observed as early as March and as late as November. Early and late records are from acoustic detectors placed along the Missouri River Valley near Helena south into Beaverhead County. Detectors placed in other areas of the species range have only detected the species between May and October. Whether the records at the limit of the active season represent migratory animals is unknown. Given the paucity of records across the eastern part of the range until later in the active season, regional migration is certainly possible but the difference in activity patterns could also be explained by differences in habitat.

In area outside of Montana Spotted Bats appear not to migrate when they are found at lower elevations (O'Farrell 1981). The species may move lower in elevation seeking conditions more favorable for overwintering (Barbour and Davis 1969, Berna 1990). As in Montana, no winter records for British Columbia (Nagorsen and Brigham 1993), but mid- or late October records from here as well as Wyoming (Priday and Luce 1999).

Habitat

Spotted Bats have been encountered or detected most often in open arid habitats dominated by Utah Juniper and sagebrush (*Artemisia tridentata* and *A. nova*), sometimes intermixed with limber pine (*Pinus flexilis*) or Douglas-fir, or in grassy meadows in ponderosa pine savannah (Fenton et al. 1987, Worthington 1991, Hendricks and Carlson 2001). Cliffs, rocky outcrops, and water are other attributes of sites where Spotted Bats have been found (Foresman 2012), typical for the global range. Spotted Bats have been captured foraging over an isolated pond within a few kilometers of huge limestone

escarpments in the Big Horn Canyon National Recreation Area, Carbon County (Worthington 1991), and the first record for the state was of an individual that flew in an open window at a private residence in Billings, Yellowstone County (Nicholson 1950). In other areas, Spotted Bats have been detected at water sources and in meadow openings, often with large cliffs nearby (Leonard and Fenton 1983, Storz 1995, Perry et al. 1997, Rabe et al. 1998, Gitzen et al. 2001).

A possible explanation for the early paucity of collections in natural situations is the Spotted Bat's narrow habitat tolerance (Handley 1959, Snow 1974).

Roost Habitat

Typical roosts for this species have not been documented within Montana. In other portions of the species range, Spotted Bats roost in caves, and in cracks and crevices in cliffs and canyons, with which this species is consistently associated; it can crawl with ease on both horizontal and vertical surfaces (Snow 1974, Van Zyll de Jong 1985). In British Columbia, individuals used the same roost each night during May through July, but not after early August (Wai-Ping and Fenton 1989). In Montana the species has been observed at dusk in proximity to smaller stature sandstone outcrops in the Bull Mountains as well as the larger cliff found along Bighorn Canyon.

Food Habits

This species is insectivorous. Apparently Spotted Bats feed primarily on noctuid moths, and sometimes beetles (Barbour and Davis 1969, Schmidly 1991, Van Zyll de Jong 1985). In Texas, the contents of 15 stomachs combined were 97.1% moths by volume, 2.7% beetles (Scarabidae), and 0.2% other insects (Easterla and Whitaker 1972); volumes in two of the stomachs were 10% and 30% beetles. In British Columbia, foraging took place 5 to 15 meters above ground (Wai-Ping and Fenton 1989). In southeastern Utah, Spotted Bats fed on small insects within 2 meters of the ground. Sometimes insects are captured on the ground (Poche and Bailie 1974), though this has been disputed. In Colorado, individuals foraged at heights above 10 meters (Navo et al. 1992). Timing and routes of foraging may sometimes be quite predictable and consistent (Leonard and Fenton 1983, Van Zyll de Jong 1985, Wai-Ping and Fenton 1989, Rabe et al. 1998). Food habits and foraging ecology in Montana have not been reported or studied.

The Spotted Bat hunts alone, and at least sometimes appears to maintain exclusive foraging areas (Leonard and Fenton 1983), although in other cases individual foraging areas overlap (Wai-Ping and Fenton 1989). Neighboring bats show evidence of mutual avoidance and have been observed to turn away when encountering one another near the boundaries of their hunting areas.

Ecology

Spotted Bats may forage quite far from roosts. In Arizona, individuals roosting in the Grand Canyon traveled more than 77 km to forage on the Kaibab Plateau (Rabe et al. 1998). In the Pryor Mountains foraging individuals have been observed in the open areas at the top of the range and these individuals likely commute from Bighorn Canyon (D. Bachen pers. obs.).

Apparently Spotted Bats are relatively solitary but may hibernate in small clusters (Easterla 1973); roosts and hibernacula are usually located in cliffs, and to some degree caves. Individuals in British Columbia roost solitarily during the active season (Leonard and Fenton 1983). Home ranges may be relatively large. Foraging 6 to 10 kilometers from the day roost each night was documented in British Columbia

(Wai-Ping and Fenton 1989); a lactating female in northern Arizona moved 38.5 kilometers between the day and night roosts, and a male flew 32 kilometers to a day roost (Rabe et al. 1998).

The echolocation call is loud and high-pitched; the fundamental frequency sweeps from 12 to 6 kHz and is a double or single steep frequency modulated pulse. The call is repeated at a rate of 2 to 6 per second and can clearly be heard by the unaided human ear at distances up to 250 meters (Van Zyll de Jong 1985), a very useful feature for determining the presence of these bats during inventory work.

Normal predators have not been reported, but recently released individuals in early morning have been attacked by American Kestrel (*Falco sparverius*), Peregrine Falcon (*F. peregrinus*), and Red-tailed Hawk (*Buteo jamaicensis*, Easterla 1973, Watkins 1977). Sources of mortality in Montana, other than human collection, have not been reported or studied.

Reproduction

Little information is available on Spotted Bat reproduction. A lactating female and a juvenile female were captured in mid-July 1990 at the same pond in Carbon County (Worthington 1991).

In the southwestern states, young are born in late May or early June (Easterla 1973, Watkins 1977); time of birth in the north may be somewhat later (Van Zyll de Jong 1985). A female in southwestern Texas gave birth to a single young on June 11 (Easterla 1973). A pregnant Spotted Bat was collected in British Columbia on June 16. Lactating females have been captured from late June to early July in New Mexico (Findley and Jones 1965, Perry et al. 1997), from mid- to late July in Nevada (Geluso 2000), and mid-August in Utah (Barbour and Davis 1969). Post-lactating females were captured on August 28 and 29 in extreme northern Wyoming (Priday and Luce 1999). All evidence points to the birth of a single young (Easterla 1973, Watkins 1977), which remains with the mother the first few days even during flight. In Texas, testis size was greatest (10 x 3 millimeters, 11 x 3 millimeters) from late June through mid-July (Easterla 1973). Mating may take place in late summer in the south, and later in the north (Nagorsen and Brigham 1993), but reproductive data from across the range are limited.

Typical population age structure and longevity are unknown, but recruitment is expected to be low, given the low birth rate. Age at maturity is also not known, but females probably give birth in their second year.

Management

Currently the Spotted bat is listed as a Montana State Species of Concern due to its perceived rarity and lack of information on much of its ecology and life history. The species is not known to be susceptible to White-Nose Syndrome or carry *Pd*, but the distribution of this species has been outside of the range of the fungus until recently (White-Nose Syndrome Response Team 2020). Significant mortality of Spotted Bats at wind energy facilities has not been observed within Montana (Poulton and Erickson 2010, Linnell and Smucker 2019) or elsewhere (AWWI 2018). General habitat management is perhaps the best way to conserve and manage the species. As the species is found in xeric environments, water sources should be maintained across the spring, summer, and into fall. Also clutter should be removed at smaller sources to provide a clear approach and departure for these larger bats. General ecosystem health should be maintained within foraging areas to ensure robust populations of invertebrate prey.

Eastern Red Bat (*Lasiurus borealis*)

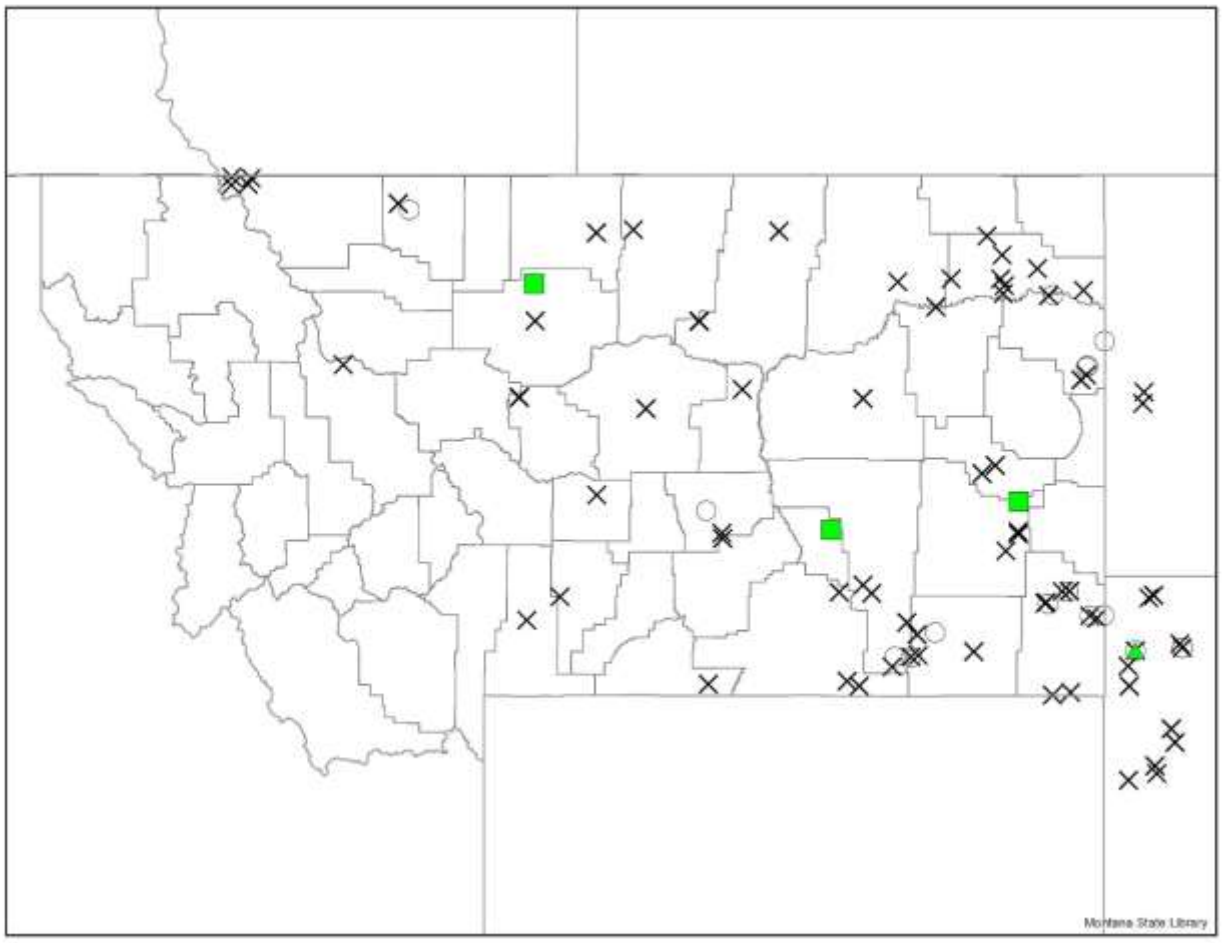

Figure 5. Observations of Eastern Red Bat in Montana. Green squares represent voucher specimens, green triangles tissue or guano samples that have been genetically verified. Open circles represent in-hand identifications from mist net captures, roost surveys or incidental encounters. "X"s are hand verified call sequences recorded with acoustic detector/ recorder units.

General Description

Eastern Red Bat is a medium sized tree roosting bat found across central and eastern Montana. Although we have resident animals that are present through the active season, many of the bats in in the late summer and early fall are believed to migrate through the state from the boreal forests of Canada to wintering areas to the south. The species is primarily known from acoustic detections and prior to the widespread use of this technology, fewer than 10 records of the species existed within Montana. Currently, Eastern Red Bat has been observe 159 times across the state.

Diagnostic Characteristics

Eastern Red Bat is Montana's only species with red/reddish brown fur. It superficially resembles its larger cousin the Hoary Bat in form if not color. It has a furred uropatagium, white wrist and elbow patches, and black wing membranes. In Montana adults typically weigh between 11.2 and 20.5 gr and forearm length is typically between 39.3 and 43mm (Bachen et al. 2017)

Mist nets placed over water and acoustics methods are both effective and efficient methods for detection of the species. During migration, mist nets placed across portions of rivers in eastern Montana near the North Dakota border have captured more than 10 individuals in a night, but success in other areas typically much lower. Animals have been captured at reservoirs and at nets set in flyways through forested areas. Acoustic recordings have been responsible for extending the rage of the species from the eastern third of the state to close to the continental divide. Call sequences are identifiable, although similarities can exist with other species present within this area (Bachen et al. 2018).

Roost surveys for this species are ineffective as Eastern Red Bats typically roost in the foliage of trees during the day, making detection through direct observation and guano collection extremely difficult (Bachen et al. 2019).

Distribution

Eastern Red Bat is found east of the continental divide in forested areas predominately along riparian corridors and coniferous forests.

Migration

Eastern Red Bat is a migratory species that is present in Montana only during the active season. Animals have been observed as early as June and as late as October, but the majority of observations are in August. Where animals migrate to overwinter is not studied in Montana. Additional animals are believed to migrate through Montana starting in late July through September. Overwintering sites are believed to be in the southern US, but are not well documented (Shump and Shump 1982a).

Habitat

The Eastern Red Bat migrates through eastern Montana, particularly along wooded and riparian areas. In other parts of its range, it is reported to prefer elm (*Ulmus* spp.), box elder (*Acer negundo*), wild plum (*Prunus spp.*), willow (*Salix* spp.), hawthorn (*Crataegus spp*.), sumac (*Rhus spp*.), and a variety of other woody plants for roosting, and hibernates in woodpecker holes, tree foliage, and under loose bark (Shump and Shump 1982a, Jones et al. 1973, van Zyll de Jong 1985). Roosts in Montana have not been documented.

Food Habits

No diet information is available from Montana. Elsewhere it is reported that Eastern Red Bat feeds on flying insects in wooded areas, often on moths (Lepidoptera) but also the Orders Homoptera, Coleoptera, Hymenoptera, and Diptera; they also feed on ground-dwelling crickets, flies, bugs, beetles, cicadas and grain moths (Shump and Shump 1982a). East of Montana they are reported to hunt around city street lights or barn flood lights and been observed foraging over water (D. Bachen Pers. Obs.)

Ecology

No information from Montana. Elsewhere, these bats tend to be solitary, roosting singly or in female-litter groups, usually in foliage or tree cavities (1 to 6 m above ground but also at ground level) near habitat edges or water. Tends not to associate with other bat species, including foliage-roosting species, except during foraging or drinking. They often begin to forage within two hours after sunset, with some feeding throughout the night. During winter they arouse from hibernation on warm days to feed. Several species of mammals and raptorial birds are documented predators of Eastern Red Bat. In the east, Blue Jays are significant predators of young (Shump and Shump 1982a, Adams 2003).

Reproduction

Little information available from Montana; two females caught on 9 and 11 August were nulliparous. Mating probably occurs during autumn migration and within the winter range, during August and September, but implantation delayed until spring. Gestation period is 80-90 days, young are born in late June and July, lactating females reported in southern Michigan in early August. Litter size ranges from 1-5, but averages about 3 (Shump and Shump 1982a).

Management

Eastern Red Bat is listed as a Species of Conservation Concern in Montana. This status is driven primarily by the threat of decline driven by wind energy development, but also by habitat degradation and lack of information. Although mortalities of this species have not been observed near turmbines in Montana (Poulton and Erickson 2010, Linnell and Smucker 2019), large numbers are killed at wind farms in other areas of the country (Hendricks et al 2003, Arnett et al. 2008, AWWI 2018). Increasing rotor start-up wind speed or changing the pitch angle of blades and lowering the required generator speed for electricity production had the same effect in reducing bat fatalities at an Alberta wind farm by 57-60% (Baerwald et al. 2009), and may be promising mitigation techniques at wind energy facilities.

Pd, the pathogenic fungus that can cause White-Nose Syndrome has been found on Easter Red Bats, but to date no individuals have been found with symptomatic WNS (White-Nose Syndrome Response Team 2020), and the disease is not a concern for this species.

Data to assess population trajectory have not been collected in Montana. In Michigan, numbers captured in paired netting surveys have declined 52-85% over 1-26 years, which corresponds to a 10-fold reduction in numbers tested for rabies during 38 years (Winhold at el. 2008). Population declines, if real, could be related to forest fragmentation, pesticides and environmental pollutants, controlled burning of leaf litter, and collisions with various man-made objects, all of which could expose the species to hazards throughout the year.

Hoary Bat (*Lasiurus cinereus*)

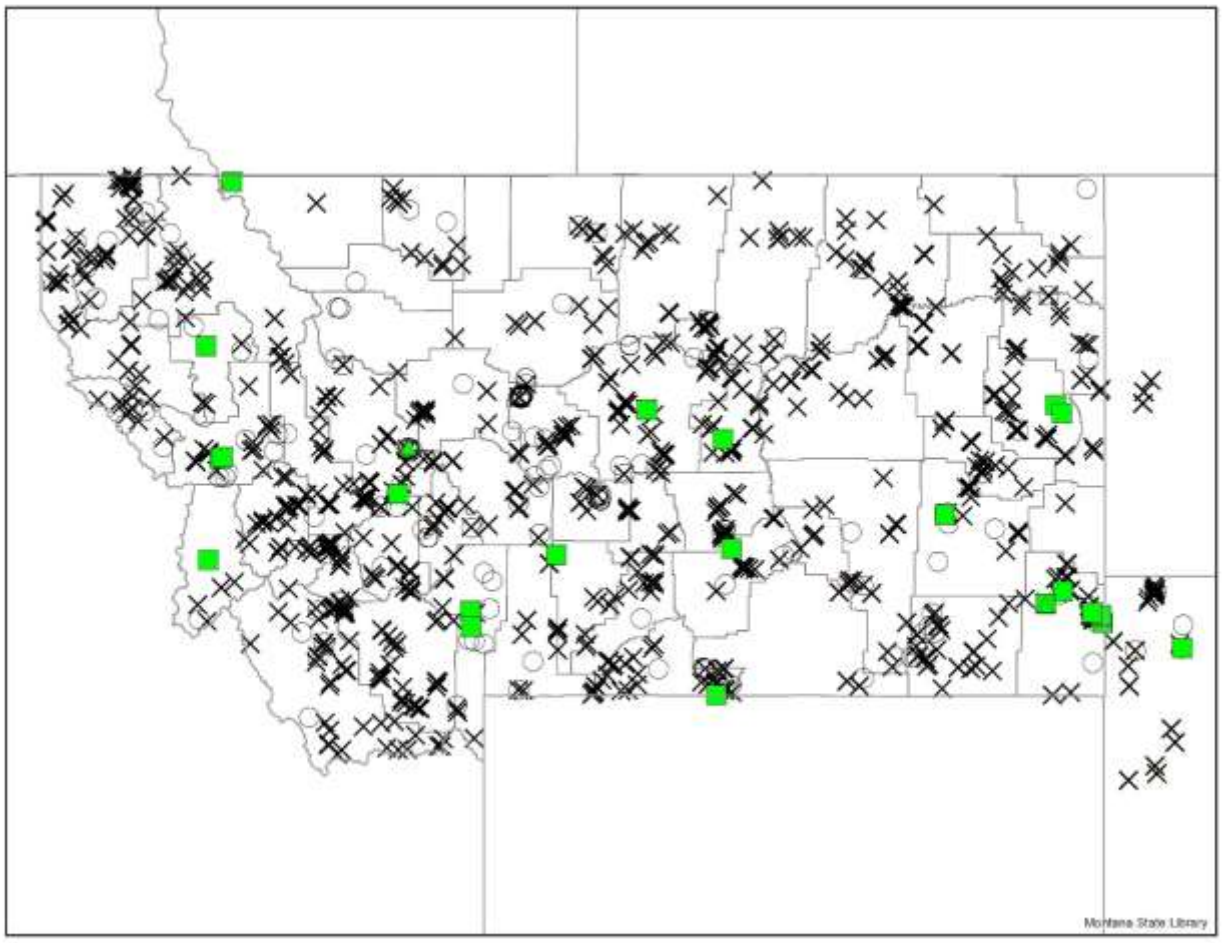

Figure 6. Observations of Hoary Bat in Montana. Green squares represent voucher specimens, green triangles tissue or guano samples that have been genetically verified. Open circles represent in-hand identifications from mist net captures, roost surveys or incidental encounters. "X"s are hand verified call sequences recorded with acoustic detector/ recorder units.

General Description

The Hoary Bat is among the largest bat species found in Montana. It is easily identified by its striking grizzled pelage and large size. Hoary Bats typically roost in the foliage of trees and rely on their size and dense fur for protection from the elements. This species is among the few bats in Montana that are known to migrate out of state during the winter, although where they migrate too is still unknown.

Diagnostic Characteristics

It should difficult to confuse the Hoary Bat with any other bat species found in Montana. The species is the heaviest and among the largest bats found in Montana (Bachen et al. 2017), and its striking coloration and physical appearance are unique among our other bat species. Hoary bats are characterized by frost tipped or hoary fur, white patches on the wrists and elbows, and a densely furred uropatagium.

Mist net capture and acoustics are both effective methods for detection of this species. Although the number of individuals captured while netting over water is rarely more than one or two, capture during

mist netting is common. The species produces long low calls that are distinct and are readily identifiable. Roost surveys and guano collection are ineffective for documentation of this species. Individuals typically roost in the foliage of trees (Shump and Shump 1982b), and as such surveys of roosts or the collection of guano are difficult if not close to impossible. Montana does have a single record of a female using a bridge as a temporary day roost, but this is atypical both within Montana and across the species North American range (Hendricks et al. 2005, Bachen et al. 2019)

Distribution

Hoary bat is found across the state in forests and adjacent area that provide habitat for foraging. Across western Montana, all individuals captured have been males. Within eastern Montana the sex ratio is still biased toward males but adult females have been reported.

Migration

Hoary bats are migratory in Montana. Individuals have been documented as early as March and as late as November but almost all observations are recorded between late May and September. Research to determine where the animals present in our region overwinter has not been conducted.

Habitat

During the active season, Hoary Bats roost within forested areas and forage in open areas adjacent to roosting sites and above the canopy. The species typically roosts in the foliage of both deciduous and coniferous trees during the day (Shump and Shump 1982). Across Montana two individuals roosting in deciduous trees along rivers have been observed. Additionally a female with two naked pups was found in mid-July using a wooden bridge in Stillwater County as a temporary day roost (Hendricks et al. 2005).

Reported in Montana over a broad elevation range (579 to 2774 m; 1900 to 9100 ft) during August, the highest record from treeline along the Gravelly Range road (Madison County), the lowest from the Yellowstone River near Sidney (Richland County); probably most common throughout summer in Montana at lower elevations.

Food Habits

The stomach contents of 7 individuals captured in Carter County (Jones et al. 1973) revealed beetles (Scarabidae and Dytiscidae), moths, true bugs (Corixidae, Miridae), leafhoppers (Cicindellidae), lacewings (Myremeleontidae, Hemerobiidae), and true flies (Anthomyiidae, Calliphoridae, Tipulidae, Chironomidae, Muscidae). Elsewhere in North America Hoary Bat appears to favor moths (Noctuidae and Geometridae), but will also consume beetles and other flying insects depending on local and seasonal availability (Shump and Shump 1982b, Valdez and Cryan 2009).

Ecology

One notable attribute of the Montana's hoary bat population is that both male and adult female bats and young have been observed within the state. During the summer Hoary bats are generally segregated by sex and geography with Males found across the western US and females across the east. Across Montana males are more common, but females have been captured in eastern and central regions of the state and young have been observed.

Reproduction

Breeding is thought to occur during the fall migration (Shump and Shump 1982b). In eastern and southcentral Montana young are thought to be born in late June based on the presence of flighted young in mid to late-July (Bachen et al. 2017). Hoary bats can have up to two pups each year although whether females breed each year is unknown.

Management

Hoary Bat is listed as a Montana Species of Concern. The primary concern for conservation and management of Hoary Bat within and outside of Montana is wind energy development, specifically mortality caused by turbines (Johnson et al. 2003, Arnett et al. 2008). Hoary Bats are among the most commonly killed species at wind turbines across North America (American Wind Wildlife Institute 2018) and in Montana (Poulton and Erickson 2010, Linnell and Smucker 2019). Fatalities of migrating Hoary Bats may be predictable events, because this species appears to be drawn to prominent landmarks that they see during migration, and this is related to autumn flocking and mating behaviors (Cryan and Brown 2007). Although the long-term impacts of this mortality is uncertain, but they may be severe and lead to catastrophic declines in the future (Frick et al. 2017). *Pd* or clinical White-Nose Syndrome has not yet been observed in Hoary Bats (White-Nose Syndrome Response Team 2020) despite the species presence in WNS impacted areas of eastern and central North America, and impacts of this disease on the species is not likely.

Silver-haired Bat (*Lasionycteris noctivagans*)

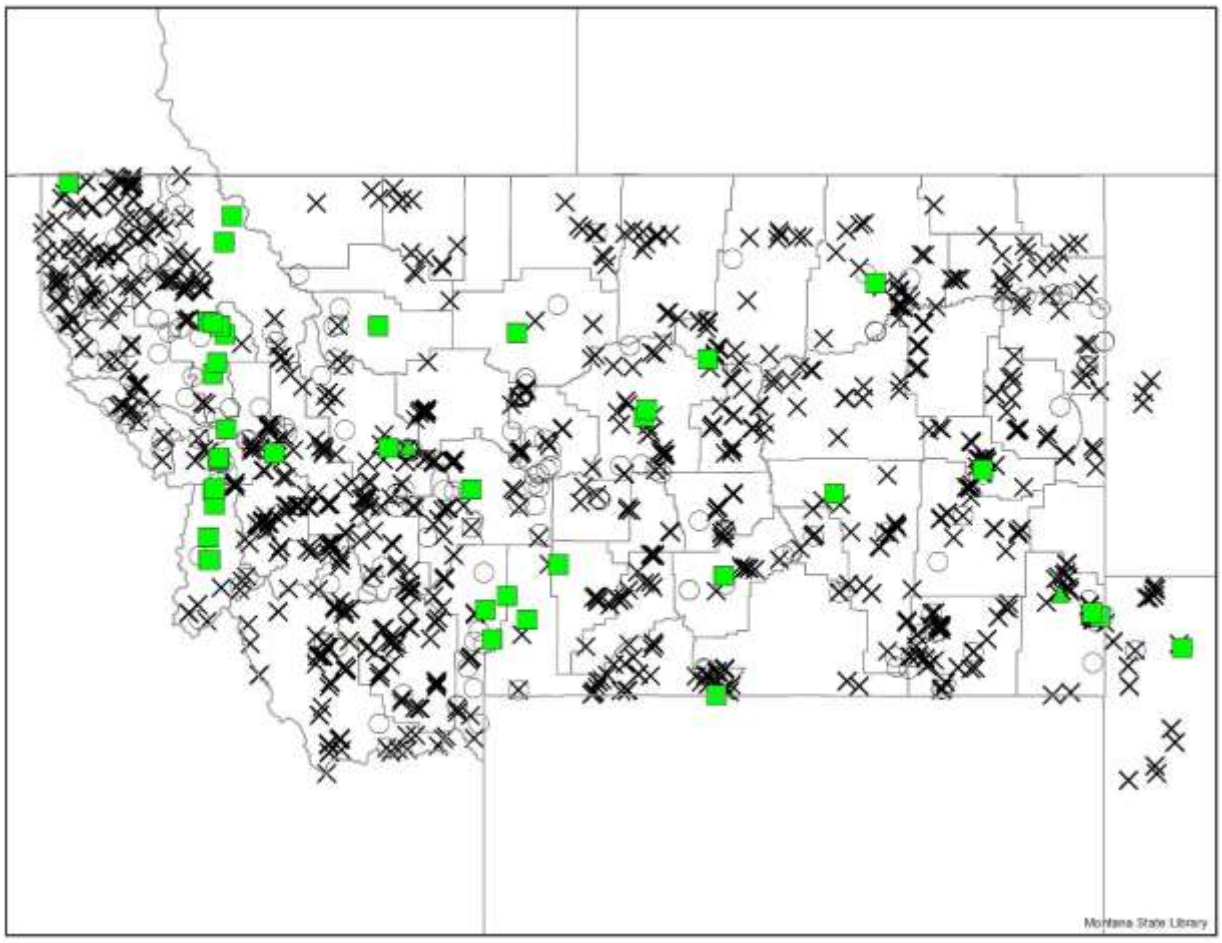

Figure 7. Observations of Silver-haired Bat in Montana. Green squares represent voucher specimens, green triangles tissue or guano samples that have been genetically verified. Open circles represent in-hand identifications from mist net captures, roost surveys or incidental encounters. "X"s are hand verified call sequences recorded with acoustic detector/ recorder units.

General Description

Silver-haired bat is a medium sized bat found across Montana. It is almost black in color with varying amounts of silver tipped hairs on the back. The species typically roosts on or in trees and forages within or near forested areas. This species is among the most commonly detected across the state and to date 1,758 observations have been reported.

Diagnostic Characteristics

Silver-haired bats may superficially resemble Myotis species, but can be easily distinguished by their dark colored fur with silver tips on the back, small ears with a light colored lower margin, and slightly larger size as well as their furred uropatagium (Kuntz 1982). The species lacks the distinctive white elbow and writs pads found in Hoary Bats, the only other Montana species with silver-tipped fur and a furred uropatagium (Bachen et al. 2018).

The call structure of Silver-haired Bat has significant overlap with the Big Brown Bat, but the species can be identified using acoustic methods (Bachen et al. 2018). The species is also readily captured when

netting over water and across flyways in forests. Roost surveys are ineffective for the species as it primarily roosts in trees. The species has been found roosting in buildings and other manmade structures like bridges, but these roost appear to be infrequently (Bachen et al. 2019) used and surveys of them to detect the species are unreliable.

Distribution

Silver-haired Bats are found state-wide within and near forested areas.

Migration

Migration of Silver-haired Bats in unstudied in Montana. The species has been recorded during the winter across the winter in western and southern regions of the state. Direct verification of species presence has not yet occurred, but the acoustic records provide evidence that at least some of the population may remain in state year-round. Across other portions of its range, a similar southern shift in detections occurs which may indicate seasonal movements of moderate distance in these areas (Kuntz 1982).

Habitat

Silver-haired bat is found in many ecosystems across the state. Species presence is closely tied to trees which provide roosts (Kuntz 1982), although animals may forage up to 3.4 km away from roosts (Campbell et al. 1996) and forage in more open habitat. Both conifers and deciduous trees are used for roosting, so few places in the state where the species is not found including the prairies of northern Montana.

Roost Habitat

Roosts in the active season are primarily larger diameter trees. In contrast to the Hoary and Eastern Red Bats, Silver-haired Bats roost in the cracks and crevices of the tree rather than the foliage (Kuntz 1982). Silver-haired Bats will also roost in more exposed sites on trees relying on their cryptic pelage to avoid predators. In Montana the species uses large diameter snags with loose bark and cavities (Schwab 2006). Winter roosts are unknown.

Food Habits

In eastern Montana the diet of this species was found to include a diversity of insect orders including: the Lepidoptera, Hemiptera (Corixidae and Cicadellidae), Coleoptera (Carabidae), Diptera, and Trichoptera (Jones et al. 1973). The diet in other areas of the state has not been studied, but given the diversity of habitats occupied the species appears to be somewhat general in its food preferences.

Reproduction

Mating occurs in the late fall or winter, and the exact timing is unknown. Once they have left their overwintering roosts, female Silver-haired Bats travel to maternity roost, usually in large diameter trees (Kuntz 1982, Schwab 2006). Female Silver-haired Bats give birth to up to two young in the early summer. In Montana, volant young have been captured as early as the second week in July and from this parturition can be inferred to begin in mid-late June (Bachen et al. 2017).

Management

Silver-haired Bats are currently a Potential Species of Concern within Montana. They are commonly killed at wind energy facilities within the state (Poulton and Erickson 2010, Linnell and Smucker 2019)

although the cumulative impacts of these mortalities are unknown at this time. *Pseudogymnoascus destructans*, the pathogen that causes White-Nose Syndrome has been detected on Silver-haired Bats, but no animals with symptomatic WNS have been found (White-Nose Syndrome Response Team 2020). Forest management practices that reduce large trees and snags on the landscape are may have some impacts, but these are unstudied in Montana.

General management should focus on promoting healthy forests with robust insect populations and accessible water sources. Additionally, monitoring of populations to determine trajectory and impacts of wind energy should be a high priority both at the project scale and state-wide.

California Myotis (*Myotis californicus*)

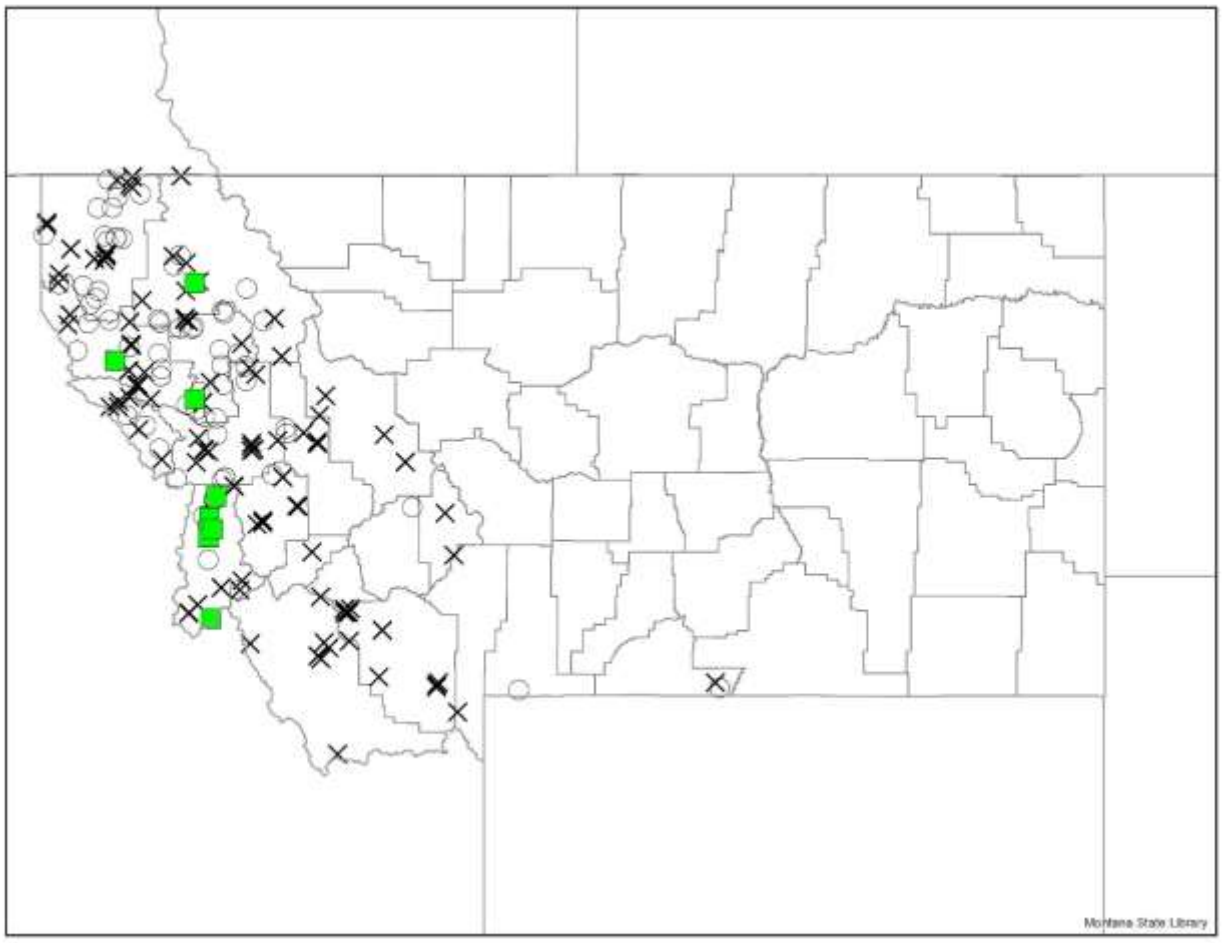

Figure 8. Observations of California Myotis in Montana. Green squares represent voucher specimens, green triangles tissue or guano samples that have been genetically verified. Open circles represent in-hand identifications from mist net captures, roost surveys or incidental encounters. "X"s are hand verified call sequences recorded with acoustic detector/ recorder units.

General Description

California Myotis species is one of the smallest Myotis species found in Montana typically weighing just 4.3-6.0 grams. It is primarily found west of the Continental Divide, but sparse records indicate its range extends into the mountains of central Montana. Although California Myotis has been observed 277 times, much of the species life history remains unstudied.

Diagnostic Characteristics

California Myotis can be identified in-hand based on morphological characteristics (Bachen et al. 2018). This species, Long-legged Myotis, and Western Small-footed Myotis are the only Myotis species with a distinctly keeled calcar, and can be identified by this feature. Size can be used to separate this species from Long-legged Myotis, as the latter is typically larger (6.5-9.3 gr) and has fur on the patagium between the chest and elbow (Bachen et al. 2017). The species most likely to be confused with California Myotis is the Western Small-footed Myotis. Both species are approximately the same size, but subtly differ in morphology. The California Myotis has a shorter and wider snout and a tail that barley

extends beyond the tail-membrane. Also the fur may appear reddish than is typical for the Western Small-footed Myotis.

Because this species can be reliably distinguished from other Myotis bats in hand, mist netting is a viable method for species detection. The species also produced diagnostic search phase echolocation calls and acoustic methods are suitable for determining species presence (Bachen et al. 2018).

Distribution

The species is generally found west of the Continental Divide, but also extends east into the mountains of central and southcentral Montana. Individuals have been captured in the Pryor Mountains and at two additional sites east of the Continental Divide, but aside from this, the species distribution in this area is defined by acoustic detections.

Migration

Migratory movements are unstudied in Montana. The species has been detected using acoustic methods during the winter November-February from the southern Flathead Valley south to Painted Rocks Reservoir in western Montana. These detections indicate year-round presence, so individuals may move locally from active season roosts to hibernaculum, but long-distance migration is unlikely. Similarly, the species has been observed during the winter in British Columbia and Washington State (Nagorsen et al. 1993, Falxa 2007).

Habitat

California Myotis is associated with conifer forests across western and central Montana. The species has been detected both within and adjacent to forested areas near water.

Roost Habitat

In Montana the species has been observed roosting in the cellar of a building, but typical roosts are believed to be in rock crevices and under tree bark. This is similar to other areas of the country where the species uses trees and rock crevices as active season roosts. In British Columbia larger more prominent trees were preferred by female bats (Brigham et al. 1997). Winter roosts have not been documented, but may be rock crevices.

Food Habits

Diet has not been studied in Montana. Across the species range a diversity of prey were consumed including Arachnida, Coleoptera, Diptera, Lepidoptera, Hemiptera, Neuroptera, and Trichoptera (Whitaker et al. 1981, Woodsworth, 1981, Kellner and Harestad 2005).

Ecology

Little is known about the ecology of this species in Montana. California Myotis has been detected in every month of the year except February, which is typical for resident bats. Like Western Small-footed Myotis, they drink soon after emerging from their roosts, and are typically among the first species captured in mist nets set over water.

Reproduction

Pregnant females have been captured in early July and juveniles and lactating females starting in mid-July. This likely indicates that parturition occurs in mid-late June (Bachen et al. 2017). Activity increase in

April and May so pregnant females likely begin to establish maternity colonies around this time (Bachen et al. 2018).

Management

To date, no specific management actions have been specifically undertaken for this species. Relative to other bat species, little is known about the life history of this species in Montana or elsewhere in its range. More research into roost preference and other aspects of the species life history is needed. Currently the species is not assigned a state or federal status. Few specific threats to persistence are currently recognized. Wind energy development does not appear to have significant impacts on California Myotis populations as mortalities have not been documented in Montana (Poulton and Erickson 2010, Linnell and Smucker 2019). Elsewhere, mortalities of the species have been documented but occur infrequently (AWWI 2018). The impacts of White-Nose Syndrome on this species are unknown. California Myotis is primarily found outside of areas impacted by WNS, so the disease will have to progress further into the species range before susceptibility to the disease and impacts on populations can be assessed. As the species roosts in trees, forest management may impact local populations. In particular harvest of potential roost trees between late May and July when maternity roosts are present could have negative impacts on these roosts.

Western Small-footed Myotis (*Myotis ciliolabrum*)

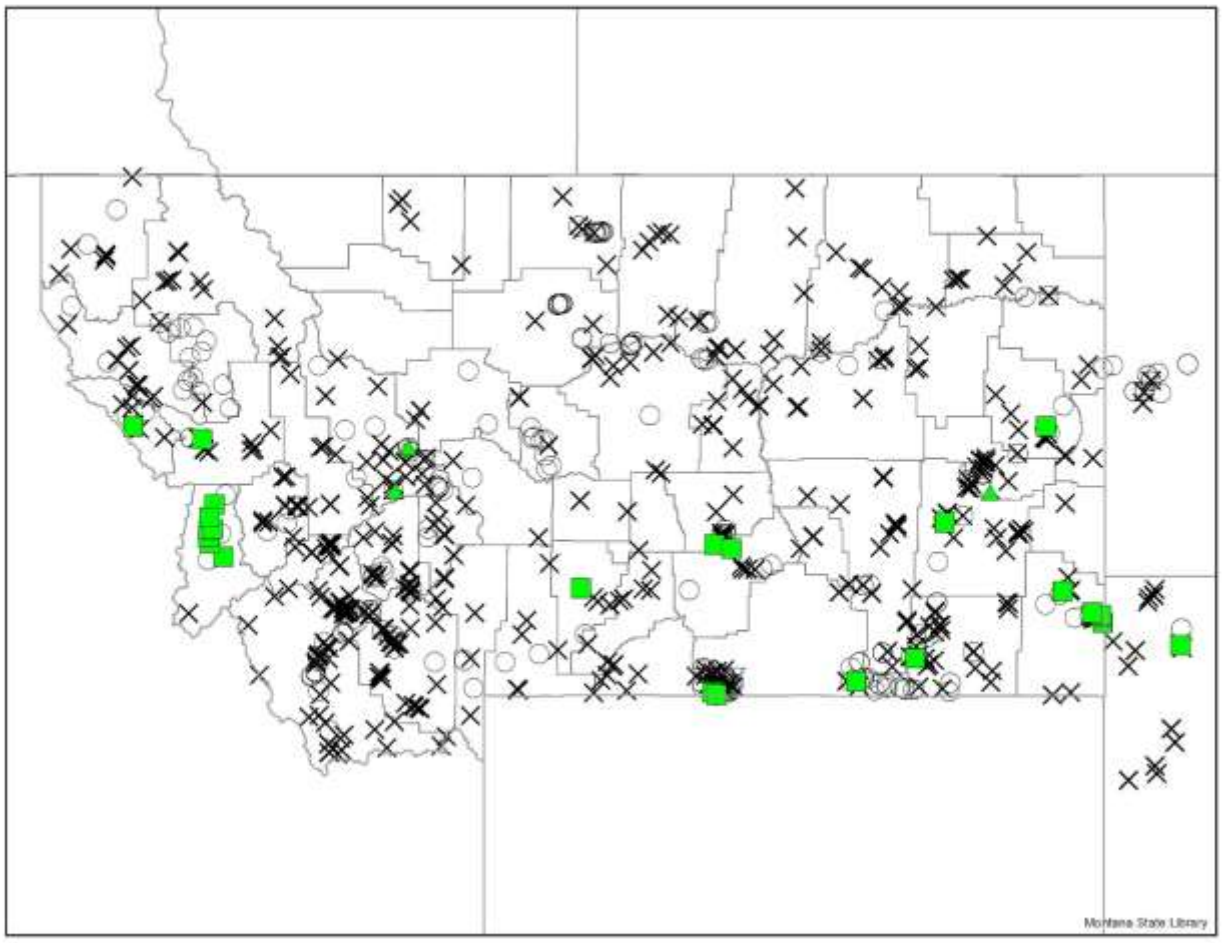

Figure 9. Observations of Western Small-footed Myotis in Montana. Green squares represent voucher specimens, green triangles tissue or guano samples that have been genetically verified. Open circles represent in-hand identifications from mist net captures, roost surveys or incidental encounters. "X"s are hand verified call sequences recorded with acoustic detector/ recorder units.

General Description

Western Small-footed Myotis is among the smallest bat species found in Montana and North America. Adults average jus 4.0-5.7 gr in weight. Despite their small size, this species is one of the most commonly detected species during the winter, and can be found in semi-exposed cracks in rocks during the active season. The species is widespread and can be moderately common, although never appears abundant. In total 1138 observations have been recorded.

Diagnostic Characteristics

Western Small-footed Myotis can be identified in-hand and through acoustic and genetic methods (Bachen et al. 2018). The species small size, light-colored fur and black "mask" are all diagnostic. It also shares a keeled calcar with the larger Long-legged Myotis and similar California Myotis. Size, fur color and contrasting black mask are useful for distinguishing the species from the former. Western Small-footed Myotis has a longer snout than the California Myotis and tail that extends significantly beyond

the uropatagium. Range can also be useful for separating both species, as they only overlap in western and forested areas of central and southcentral Montana.

Western Small-footed Myotis can be captured in mist nets placed over water and within flyways in forested areas. It is often one of the first species to be captured during the night and its small size and calm disposition make it easy to handle (D. Bachen pers. obs.). Surveys of rock outcrops are also an effective method to detect the species. Since they can be easily distinguished from other rock roosting Myotis species (e.g. *M. evotis*). The species' echolocation calls can be readily distinguished from other Myotis species and acoustic methods are effective for determining species presence (Bachen et al. 2018). Genetic methods are also effective and the species has been detected at bridges and rock roosts by analyzing guano samples (e.g. Bachen 2019).

Distribution

Western Small-footed Myotis is found across Montana

Migration

Based on year-round detections of the species, Western Small-footed Myotis does not appear to migrate long distances to over-winter. Local migration has not yet been studied in Montana. Winter activity has been observed near rock outcrops used during the active season in southeast Montana (Bachen et al. 2020a), and in this area it appears that the species is found in the same general area across the year.

Habitat

The species has fairly broad habitat associations. It is commonly found in forests, shrublands, and grasslands usually associated with rock outcrops and badlands and other rugged terrain. The species appears to be more common in the valley bottoms and open habitats of western Montana, but it has been observed in thicker more mesic forest.

Roost Habitat

The use of rock crevices during the active season is well documented for this species both in Montana (Bachen et al. 2019) and across the species range (Holloway and Barclay 2001). Structures like bridges (Bachen 2019) and buildings (Bachen et al. 2019). In Montana individuals have been found roosting in both caves and mines (Jones et al. 1973, Hendricks 2012) to overwinter. However, the species has been detected during the winter in areas that lack these features, so alternative hibernacula such as rock crevices and erosion cavities may also be used.

Food Habits

Food habits are unstudied in Montana. In other portions of its range prey items are reported to include Coleoptera, Diptera, Hemiptera, Lepidoptera, and Trichoptera (Holloway and Barclay 2001). Radio tagged individuals in Oregon traveled between 6 and 24 km round trip between foraging areas and roosts (Rodhouse and Hyde 2014).

Ecology

The ecology of his species is relatively unknown. Western Small-footed Myotis have been documented across the state in both the active season and winter. They are frequently recorded with acoustic

monitoring methods near rock outcrops during the winter (Bachen et al. 2018). This winter activity is somewhat surprising given their small size.

Reproduction

Parturition is poorly defined for this species in Montana. Juveniles have been observed as early as mid-July which suggests that parturition begins in mid to late-June, similar to other Myotis species (Bachen et al. 2017). Across the species range females typically give birth to one pup but two have been observed (Holloway and Barclay 2001).

Management

Western Small-footed Myotis has not been assigned a special status by state or federal agencies and no specific management actions are known to be taken on the species behalf. Perhaps the greatest potential threat to species persistence is White-Nose Syndrome, but as there is little overlap between the areas impacted by the disease and this species distribution, susceptibility and impacts are as yet unknown. The fungus (*Pd*) has been found on this species, but no individuals with symptomatic WNS have been observed (White-Nose Syndrome Response Team 2020). Although WNS is a concern, it appears that this species in not impacted by wind energy as mortalities near turbines have not been documented within or outside of Montana (Poulton and Erickson 2010, AWWI 2018, Linnell and Smucker 2019).

Long-legged Myotis (*Myotis volans*)

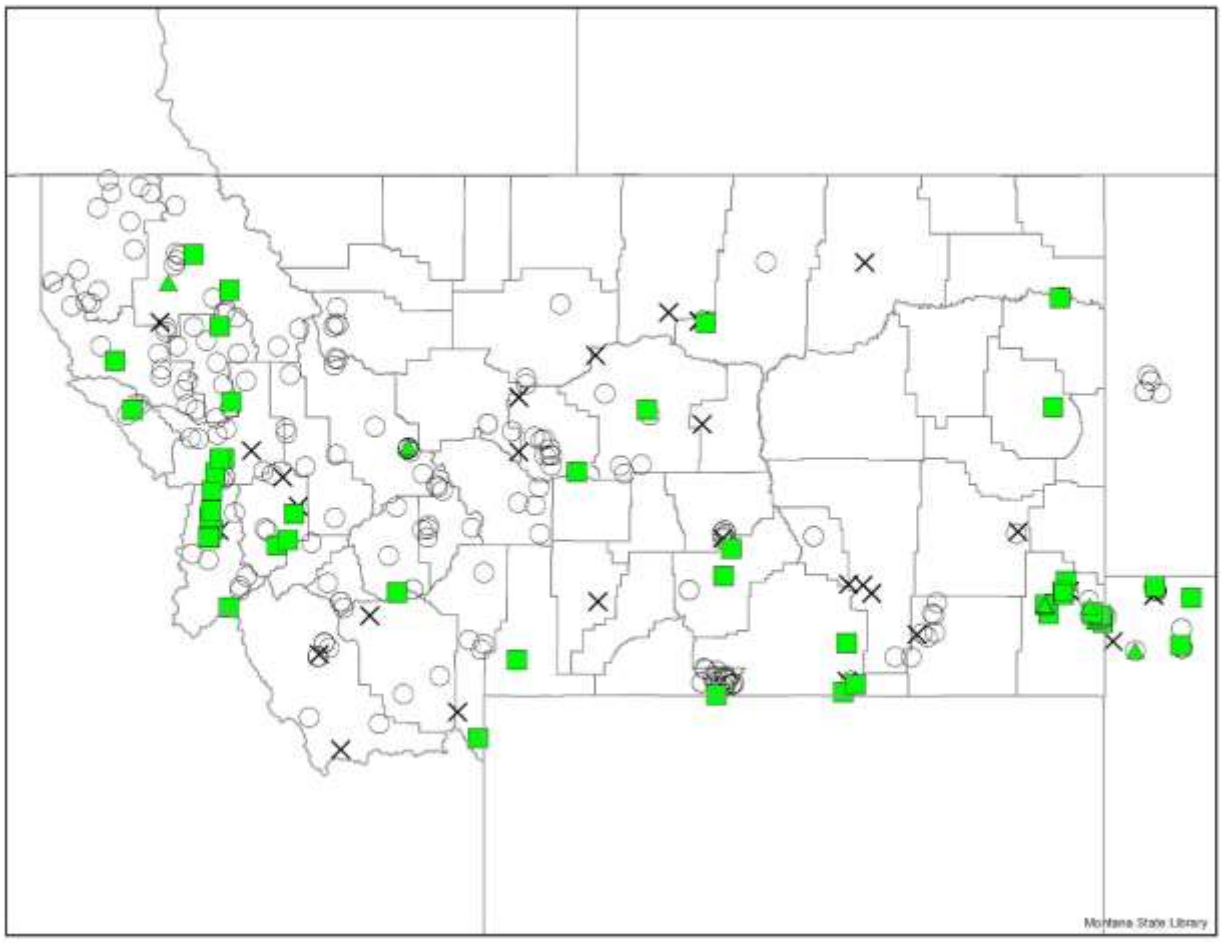

Figure 10. Observations of Long-legged Myotis in Montana. Green squares represent voucher specimens, green triangles tissue or guano samples that have been genetically verified. Open circles represent in-hand identifications from mist net captures, roost surveys or incidental encounters. "X"s are hand verified call sequences recorded with acoustic detector/ recorder units.

General Description

Long-legged Myotis is one of the more common Myotis species found in Montana. It is usually associated with conifer forests across the state. Despite frequent captures while mist netting in suitable habitat, only 320 observations of this species have been reported. The reason for this paucity of observations is that the echolocation calls typically made by the species are indistinguishable from other *Myotis* bats and rarely attributable to the species.

Diagnostic Characteristics

Like most other Myotis Bats, Long-legged Myotis is difficult to identify without detailed examination of morphological attributes. The species has brown fur and brown membranes with short to intermediate length ears and resembles the Little Brown Myotis. However, with careful examination of morphological characteristics it is possible to identify this species with confidence. Long-legged Myotis is one of the three Myotis species in Montana that has a keeled calcar and can be separated from the California

Myotis and Small-footed Myotis by its larger size and pelage coloration. It also has a well-furred patagium between the elbow and body.

Mist net surveys of waterbodies and flyways in conifer forests are effective for detection of this species, and this technique is the most efficient way to surveys for the species. Roost surveys are of limited value. The species is encountered during surveys of rock outcrops and structures during the active season and in caves and mines during the winter (Bachen et al. 2019). These roosts can be surveyed efficiently, but tree roosts, which the species also uses in Montana (Schwab 2006) are difficult to survey without using telemetry.

Although the species is easy to record using acoustic methods, its call sequences are often indistinguishable from other Myotis species (Bachen et al. 2018). As such, acoustic methods are inefficient for determining species presence.

Distribution

Long-legged Myotis is found across Montana, within or in proximity to coniferous forest.

Migration

Long-legged Myotis have been observed in all months except January in Montana. Individuals are thought to overwinter in proximity to summer range (Warner and Czaplewski 1984). However, migration has not been studied and the distance between active season roosts and overwintering locations is unknown.

Habitat

Long-legged Myotis is associated with coniferous forests state-wide. Across North America it is primarily associated with conifer forests, but is occasionally found in more xeric habitats and in riparian corridors (Warner and Czaplewski 1984).

Roost Habitat

Long-legged Myotis use a diversity of roost features during the active season. Within Montana maternity roosts have been found in large diameter trees (Schwab 2006). In South Dakota near the Montana border a large maternity colony was found behind a sandstone flake on a south facing cliff (Bachen 2019). Day roosts have been observed in buildings, mines, caves, and trees (Bell et al. 1962, Hoffman et al. 1969, Swenson et al. 1977, Hendricks et al. 2000, Schwab 2006). Hibernating individuals have been infrequently observed in caves and mines (Hendricks et al. 2000, Swenson and Shanks 1979, Hendricks 2012, Bachen et al. 2019), but other features are likely used.

Food Habits

Moths are reported to comprise much of the diet in North America, but diet is unstudied in Montana. In Idaho Lepidoptera was approximately half of the diet with beetles comprising approximately a third of captures (Johnson et al. 2007)

Ecology

Little is known about the ecology of this species in Montana. Based on the timing of observations, active season appears to start in late April and end in October.

Reproduction

Breeding likely occurs in the fall or winter (Warner and Czaplewski 1984). Upon emerging in the spring females form maternity colonies. Based on observations of volant young starting in mid-July, parturition appears to begin in mid to late-June (Bachen et al. 2017).

Management

Long-legged Myotis has not been assigned a special status by state or federal agencies and no specific management actions are known to be taken on the species behalf. However as White-Nose Syndrome continues to spread across western North America, this may change. Individuals have been found with symptomatic WNS (White-Nose Syndrome Response Team 2020). At this time impacts of this disease at the population level are unknown. Impacts of wind energy development are not a concern for this species at this time. Although fatalities have been reported in North America, they are very infrequent (AWWI 2018), and population level impacts seem unlikely.

Little Brown Myotis (*Myotis lucifigus*)

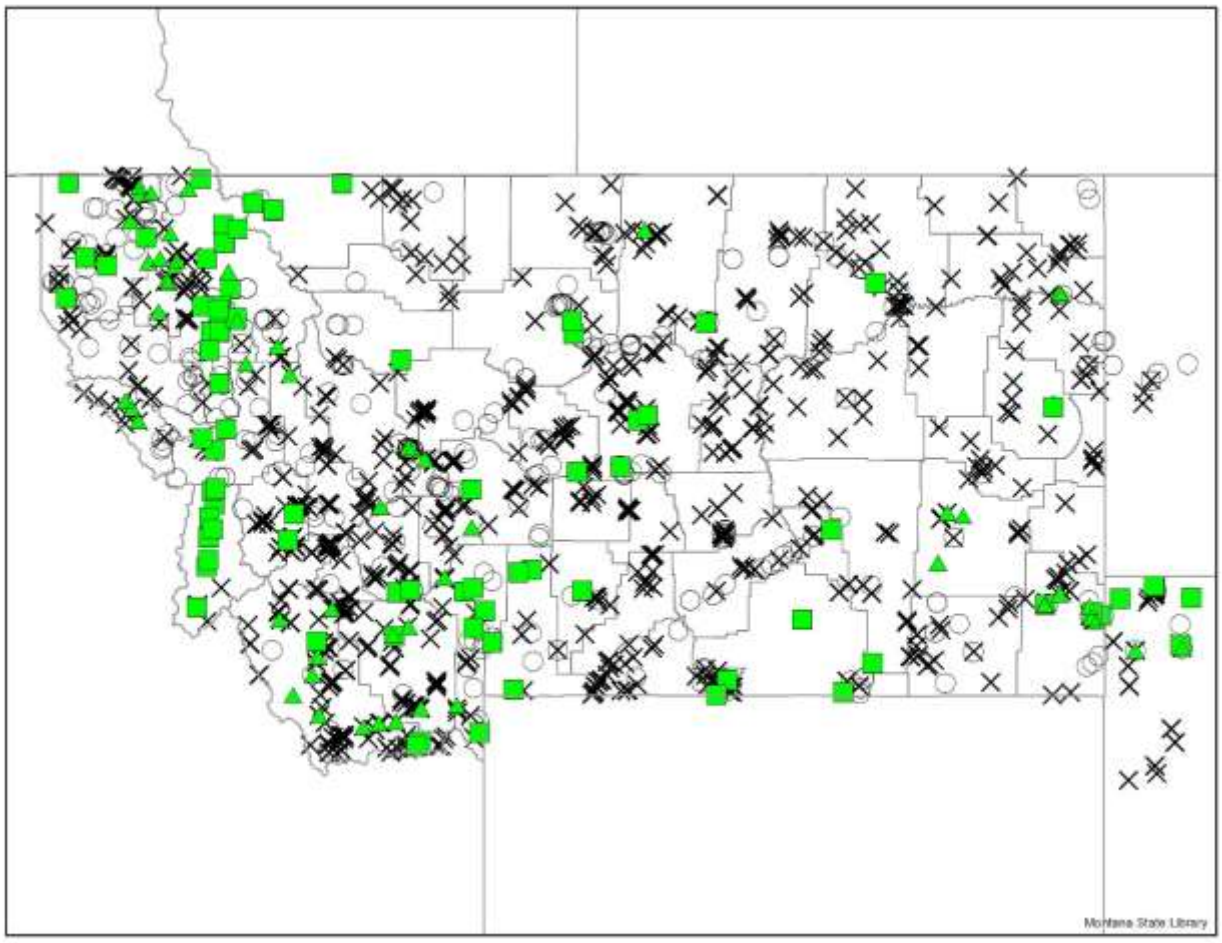

Figure 11. Observations of Little Brown Myotis in Montana. Green squares represent voucher specimens, green triangles tissue or guano samples that have been genetically verified. Open circles represent in-hand identifications from mist net captures, roost surveys or incidental encounters. "X"s are hand verified call sequences recorded with acoustic detector/ recorder units.

General Description

Little Brown Myotis (a.k.a. Little Brown Bat) is among the most ubiquitous bats found in Montana. The species is distributed across the state and has been observed almost everywhere suitable roosts are found. The species typifies the *Myotis* genus in the state and animals typically have dark brown to blond pelage, ears of intermediate length and brown membranes. Little Brown Bats will readily use man-made structures as roosts and can form colonies of hundreds to thousands in houses, barns, and bridges which makes them one of the most frequently encountered bats by the general public. Unfortunately, they are also susceptible to White-Nose Syndrome and have experienced severe declines due to this disease in other areas of North America.

Diagnostic Characteristics

Across much of their range in Montana, Little Brown Myotis are identifiable by the species' unique morphological characteristics. Adults typically have forearm lengths measured between 35 and 40 mm. Individuals have brown fur and membranes, ears of intermediate length (12-14 mm) that do not reach

the end of the nose when pushed forward, and lack a keeled calcar (Bachen et al. 2019). The presence of a keel separates them from M. Volans, and total ear length and ear length relative to muzzle length can be used to distinguish them from Long-eared Myotis (*M. evotis*), Fringed Myotis (*M. thysanodes*), and Northern Myotis (*M. septentrionalis*) as these other species all have ears that exceed the length of the muzzle. As characteristics vary by individual, occasionally some individuals may resemble other species (particularly Northern Myotis, see Bachen 2019 for example and discussion), and in these cases genetic testing is recommended to confirm species identity.

The species most likely to be confused with Little Brown Myotis is Yuma Myotis (*M. yumanensis*). Yuma Myotis so closely resembles Little Brown Myotis that only a portion of either species can be identified using morphology where they co-occur in western Montana. As adult Little Brown Myotis can be larger individuals with forearm lengths exceeding 36.5 mm are most likely Little Brown Myotis. If characteristic frequency of calls can be measured, individuals with calls below 44 kHz are also likely to be Little Brown Myotis. Yuma Myotis typically has a characteristic frequency of greater than 47 kHz (Weller et al. 2007). However, individuals exist that cannot be identified using these features and genetic testing is necessary to confirm species.

Detection of Little Brown Myotis can be accomplished with all common survey methods used in Montana. The species produces a characteristic search phase call sequence so acoustic monitoring is effective (Bachen et al. 2018). The species is also relatively unique and can be reliably identified in-hand, except where it co-occurs with Yuma Myotis. Genetic testing can reliably distinguish this species from all others in the state.

Distribution

Found state-wide wherever suitable roosts are located.

Migration

Currently migration between summer range and overwintering locations is largely unknown for this species in Montana and elsewhere. Little Brown Bats have been detected in all months of the year using acoustic methods and hibernacula surveys, so some individuals if not all of the population remains in-state. Hundreds to thousands of bats have been observed overwintering in caves within the Pryor and Little Rocky Mountains of central and southern Montana (Bachen et al. 2019). Individuals have been observed traveling 10 to 647 km from hibernacula to summer colonies in Manitoba and northwestern Ontario, Canada (Norquay et al. 2013), so it is possible that bats in Montana migrate locally or regionally to exploit suitable overwintering sites. However, maternity colonies and other summer aggregations can be similar in size to known hibernacula within the state, so overwintering sites may only be used by local animals.

Habitat

Little Brown Myotis are found across the majority of Montana's ecosystems and are generally associated with both small and large waterbodies and roost features like trees and rugged landscapes that provide rock outcrops and other cracks and crevices (Bachen et al. 2018 and Bachen et al. 2019).

Roost Habitat

Little Brown Myotis exploit a variety of structures for roosts. Summer day roosts are found within trees, rock crevices, buildings, bridges, caves, and bat houses (Bell and Thomas 1964, Hendricks et al. 2000,

Schwab 2006, Bachen 2019). Maternity colonies have been observed in buildings, under bridges and in bat houses (Bachen et al. 2019). Across North America maternity roosts have been observed in trees and rock crevices (Fenton and Barclay 1980). Within Montana, the species has been observed using caves and mines to overwinter, sometimes in groups of hundreds to thousands (Swenson and Shanks 1979, Hendricks 2012, Bachen et al. 2019).

Food Habits

Little Brown Myotis consume a diversity of insect species, but favor aquatic insects (Fenton and Barclay 1980).

Ecology

Little brown Myotis is one of the few species for which we have longevity data within the state. Two banded bats were recovered from Little Ice and Mystery Caves in the Pryor Mountains. These individuals were banded during research conducted between 1989 and 1991 (Worthington 1991) and died of natural causes and were recovered in 2016 and 2017 respectively. Both were males and had a minimum age of 27 and 29 based on the date of banding (D. Worthington Pers. Com.)

Reproduction

Reproduction of Little Brown Myotis has not been studied in Montana. In northern latitudes, individuals begin to aggregate at swarming (breeding) as early as late July and August (Fenton and Barclay 1980). Observations of breeding and swarming animals at Azure Cave in North Central Montana in late July support indicate similar timing in part of the state (D.Bachen pers. obs.). Swarming occurs in proximity to hibernacula, and females are impregnated in the fall or winter, but delay fetal development until after spring emergence. Based on capture data and roost surveys, it appears that in Montana young are born in July and begin to become volant by early August. Females typically bear a single pup, and may not breed each year (Fenton and Barclay 1980).

Management

Within Montana Little Brown Myotis is currently listed as a Species of Concern due to the treat of White-Nose Syndrome. WNS has caused the collapse of populations of this species across eastern North America (Turner et al. 2011). In 2020 Pd, was detected in eastern Montana (White-Nose Syndrome Response Team 2020), so impacts from WNS may begin to occur over the next few years.

In addition to WNS related threats and impacts local populations can be impacted by disturbance or removal of maternity colonies, particularly those found in man-made structures such as bridges and buildings. As the species uses trees (Schwab 2006), forest management may impact local roost availability. Unlike some other bat species, Little Brown Myotis does not appear to be impacted by wind energy development. At both the Judith Gap and Spion Kop sites no mortalities were documented during post construction monitoring despite the species presence as documented on acoustic recorders placed near the turbines (Poulton and Erickson 2010, Linnell and Smucker 2019, Bachen et al. 2020b).

Yuma Myotis (Myotis yumanensis)

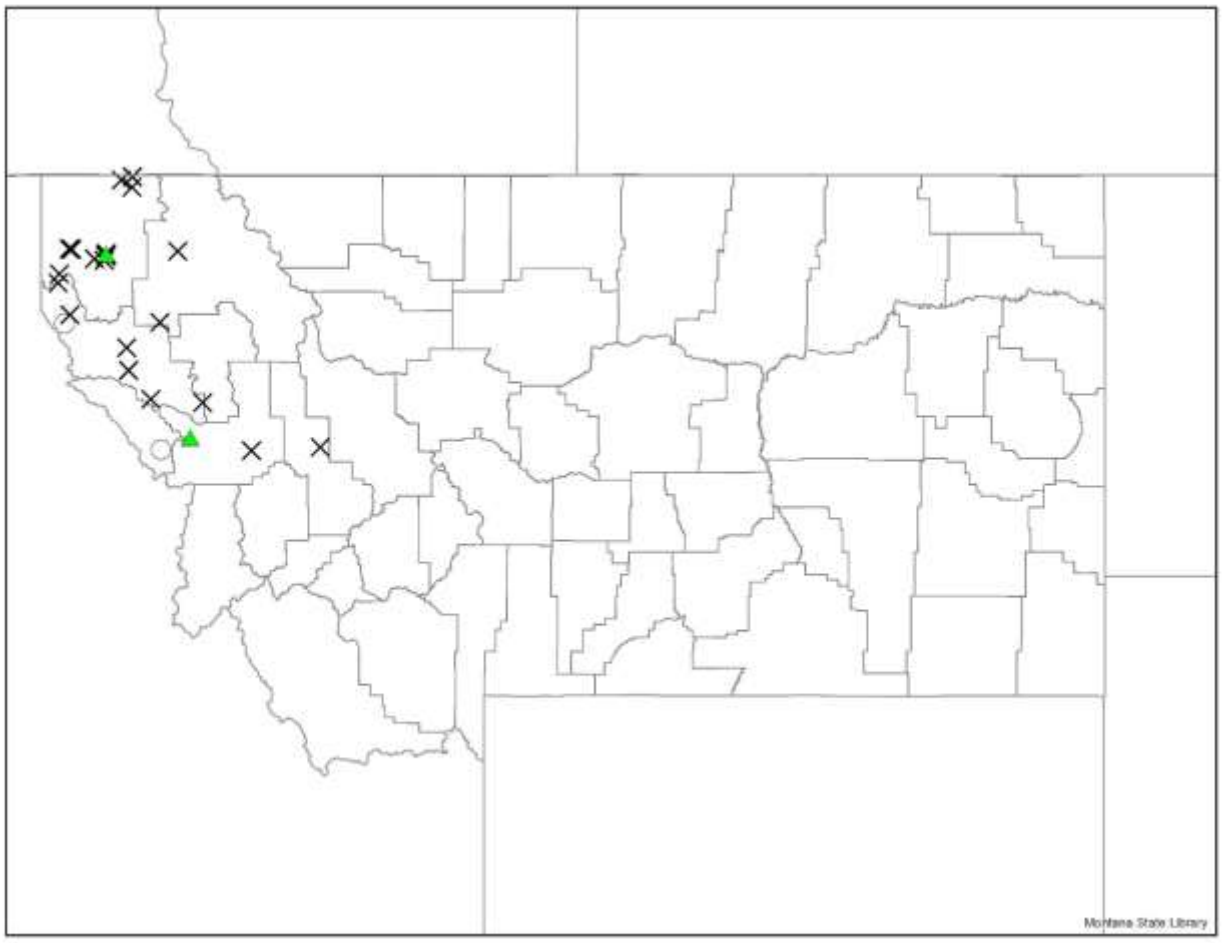

Figure 12. Observations of Yuma Myotis in Montana. Green squares represent voucher specimens, green triangles tissue or guano samples that have been genetically verified. Open circles represent in-hand identifications from mist net captures, roost surveys or incidental encounters. "X"s are hand verified call sequences recorded with acoustic detector/ recorder units.

General Description

Yuma Myotis is a typical *Myotis* bat very similar in appearance to the Little Brown Myotis. In Montana the species is primarily associated with forested areas in the northwest region of the state. Due to the similarity in appearance to the Little Brown Myotis, it is possible that the species is both more common and more widespread than currently known. To date there are 59 observations.

Diagnostic Characteristics

Yuma Myotis are difficult to identify in-hand as they are nearly identical in appearance to the ubiquitous Little Brown Myotis. The species can be distinguished from the long-eared Myotis species (Long-eared Myotis and Fringed Myotis) as its ears are less than 14 mm in length and frequently at or below 12 mm. It can be distinguished from the Long-legged Myotis because it does not have a distinct keel on its calcar (Bachen et al. 2018). It is possible to distinguish between Yuma and Little Brown Myotis, but this requires detailed morphological data, echolocation data, and possible collecting tissue or guano for identification using genetic methods (Weller et al. 2007). To identify an individual a forearm

measurement is taken and when the individual is released an acoustic detector is used to record the animal's echolocation calls. Individuals with a forearm length of less than 36.5 mm and call sequences with a characteristic frequency of greater than 47 kHz can be definitively identified as Yuma Myotis. If the forearm is under 36.5 but the characteristic frequency is less than 44 kHz the animal is likely a Little Brown Bat. If the characteristic frequency is between 44 and 47 kHz the animal can only be distinguished using genetic methods.

Due to the difficulties identifying this species in-hand mist net and roost surveys are only effective if the surveyor is prepared to collect acoustic recordings and genetic samples. Acoustic detectors and passive collection of genetic material at roosts provide good alternatives for detection of the species. Most records from Montana are based on recorded call sequences, and this is a viable and efficient method of survey (Bachen et al. 2018). Genetic identification of guano has also been effective for detecting the species at roosts.

Distribution

Yuma Myotis has been observed west of the Continental Divide. The species range may extend further east and south, but to date no robust evidence of species presence outside of the current range has been found.

Migration

Across Montana Yuma Myotis has only been observed between April and September. Whether this is due to low winter activity that was not detected as has been reported elsewhere (Boyles et al. 2006), or that the species migrates to areas more favorable for hibernation is currently unknown. In milder portions of the species range it does not appear to migrate long distances or even completely hibernate (Braun et al. 2015). Cave surveys conducted within the species range have detected individuals that could be either Little Brown Myotis or Yuma Myotis, but these individuals were not definitively identified to species.

Habitat

In Montana Yuma Myotis is associated with coniferous forests and open valley bottoms, usually near lakes, reservoirs and rivers. Across the species range in North America, the species occupies a suit of diverse ecosystems from deserts, to shrublands, and even mesic coastal forests (Braun et al. 2015). However, proximity to waterbodies such as lakes and ponds appear to be driving habitat selection (Duff and Morrell 2007).

Roost Habitat

Roosts in Montana are poorly described for this species. Active season and maternity roosts have been found in man-made structures including bridges, buildings, and bat houses (Bell et al. 1962, Bachen et al. 2019). At one maternity colony in a bat house, Yuma Myotis co-roosts with Little Brown Myotis. As in Montana, natural roost features used during the active season are poorly described across other portions of the species range (Braun et al. 2015). Those that have been described include, rock crevices and swallow nests made of mud, large diameter trees, and caves as well as man-made structures like bridges (Dalquest 1947, Licht and Leitner 1967, Nagorsen and Brigham 1993, Evelyn et al. 2004, Geluso and Mink 2009).

Food Habits

The diet of Yuma Myotis is unstudied in Montana. Across the species range in North America a wide diversity of prey are consumed including insects from the orders: Coleoptera, Diptera, Ephemeroptera, Hemiptera, Homoptera, Hymenoptera, Isoptera, Lepidoptera, Neuroptera, Orthoptera, Trichoptera and arachnids (Braun et al. 2015).

Ecology

Little is known about the ecology of the species in Montana.

Reproduction

Almost nothing is known about reproduction in Montana as in-hand observations are sparse. Maternity colonies have been found in man-made structures (Bachen et al. 2019), so the species does breed. Data with sufficient detail were not collected from these roosts to determine when parturition typically occurs. It is likely that maternity roosts begin to be occupied in April and May as females leave their hibernaculum, and pups are born in mid-late June similar to other *Myotis* species in Montana (Bachen et al. 2017).

Management

The Yuma Myotis is currently listed as a Species of Concern in Montana. This status is due to not only the lack of information on basic life history and ecology, but also due to the threat of severe declines caused by White-Nose Syndrome. As this species of bat occurs primarily in western North America, the impacts of WNS on populations are not currently known. Individuals have been found with symptomatic WNS (White-Nose Syndrome Response Team 2020), and there exists the potential for severe declines if the disease has similar impacts as it has on eastern bat species (e.g. Turner et al. 2011). Like other Myotis species, wind energy does not appear to be a threat to population persistence. Fatalities were not reported in studies at two sites outside of the species range in central Montana (Poulton and Erickson 2010, Linnell and Smucker 2019), and mortalities of the species have not been observe elsewhere in North America (AWWI 2018). The biggest impact managers can have on this species is through minimizing disturbance of colonies in buildings, and if removal is desired, following best practices and working to exclude bats outside of the active season (working between October and April).

Northern Myotis (*Myotis septentrionalis)*

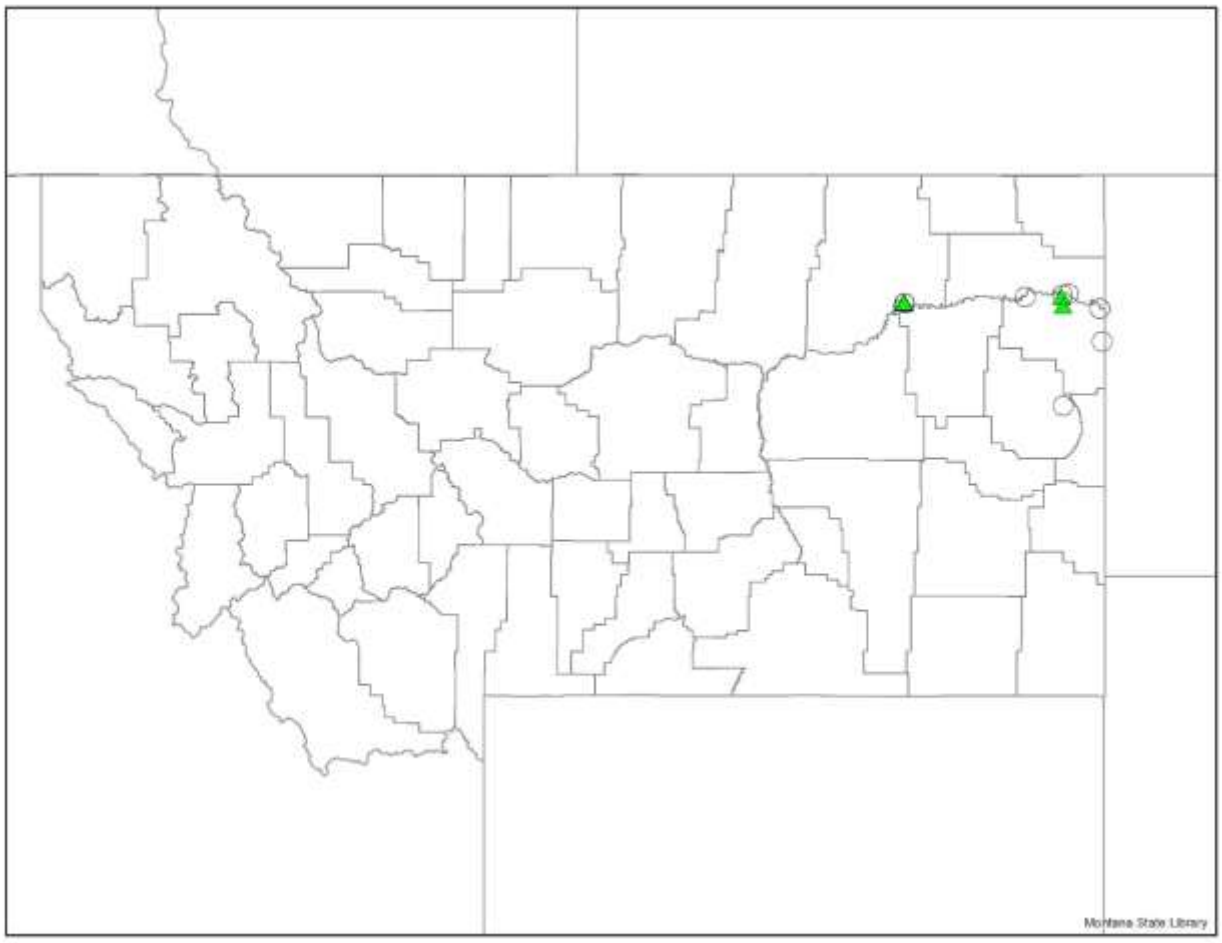

Figure 13. Observations of Northern Myotis in Montana. Green squares represent voucher specimens, green triangles tissue or guano samples that have been genetically verified. Open circles represent in-hand identifications from mist net captures, roost surveys or incidental encounters. "X"s are hand verified call sequences recorded with acoustic detector/ recorder units.

General Description

Northern Myotis is one of Montana's rarest bat species, and the only species currently listed under the Endangered Species Act. It has relatively long ears (14-19 mm) extending < 5mm beyond the nose when pushed forward, a long pointed tragus, forearm length 34-38 mm, hind foot length 8-10 mm and tail length 35-42 mm; the calcar lacks a prominent keel (but a slight keel may be present), and the fringe of the tail is hairless or with only a few sparse hairs. Pelage and membranes are brown and usually the same color. Females are generally larger and heavier than males. Dental formula is I 2/3, C 1/1, P 3/3, M 3/3 (Nagorsen and Brigham 1993, Caceres and Barclay 2000, Adams 2003).

Diagnostic Characteristics

Northern Myotis can be difficult to distinguish from Little Brown Myotis and other long-eared Myotis species in-hand as it has characteristics shared by both groups (Bachen 2019). Northern Myotis can be distinguished in the hand from Little Brown Myotis by the longer ears that are longer than 14 mm which extend beyond the snout when pushed forward. Pelage color is similar and not diagnostic. Long-eared

Myotis has darker membranes and paler pelage, and the ears are longer and will typically extend 5mm or more past the end of the nose when pushed forward. Generally, Northern Myotis has more pink skin visible around the lips and eyes, and is slightly smaller. However, these features are not diagnostic. As some exceptional Little Brown Myotis and Long-eared Myotis closely resemble Northern Myotis, the current best practice is to collect a tissue or guano sample to confirm species identity using genetic methods.

As the species echolocates quietly and is often found within heavily cluttered environments, acoustic methods have not been successfully used to determine species presence in Montana. To date placing mist nets across flight coridors in deciduous forests has been the only method that consistently detects the species in the active season (Bachen 2019). Roost surveys have been successfully used to documented species presence. In one instance the species was detected through the analysis of a guano sample collected under a bridge. One individual was also found during a hibernacula survey of an abandoned coal mine (Swenson and Shanks 1979), so this may also be a viable method for detection of the species as well provided the hibernacula is safe to enter.

Distribution

The current know distribution of Northern Myotis follows the Missouri River from Fort Peck to the North Dakota border and the Yellowstone River from the Glendive area downstream to the border. Surveys of potential riparian forest along the Missouri and Milk rivers have not been completed, so further expansion of the species range to the west is possible.

Migration

Migratory patterns of Northern Myotis are unstudied in Montana. The single known hibernaculum is located in the hills above the forested areas along the near-by river where adults and juveniles were captured during the active season (Swenson and Shanks 1979, Bachen 2019). Local movements from forest to mines or other suitable features like erosion cavities in badlands are likely across the species rang in Montana.

Habitat

Across the species range, Northern Myotis is generally associated with forested areas (Caceres and Barclay 2000). In Montana Northern Myotis has been exclusively found in deciduous riparian forests typically dominated by cottonwoods, Green Ash (*Fraxinus pennsylvanica*), and Box Elder during the active season. In Wyoming and South Dakota, the species has been found in coniferous forests (Cryan et al. 2001, Geluso and Borgan 2018) and in mixed conifer and deciduous forests (Keinath and Abernethy 2016).

Roost Habitat

In the only study of active season roosts in Montana, post-lactating females were found to mature Eastern Cottonwood (*Populus deltoids*) as roosts. Other information on active season roosts is lacking, but are likely to be in deciduous trees. A single hibernaculum has been identified in an abandoned coal mine (Swenson and Shanks 1979), but surveys of suitable hibernacula are very limited as many of these mines are unsafe to enter and erosion cavities that appear to provide similar habitat are also unstable.

Food Habits

No food habits information is available from Montana. Range-wide, Northern Myotis feed on a variety of insects, oftentimes gleaning insects from foliage and sometimes from the ground (Caceres and Barclay 2000).

Ecology

Ecology of Northern Myotis is unstudied in Montana, and survey data are limited.

Reproduction

Few data exists to infer reproduction in Montana. The species is assumed to reproduce in the state based on the capture of all age classes and sexes. Lactating females and a juvenile were captured in mid-July near Fort Peck, and post-lactating females and juveniles have been captured at other sites along the Yellowstone and Missouri rivers during August surveys. Based on the timing of capture of lactating females and juveniles, parturition likely occurs in late-June similar to other *Myotis* species. However, this is based on data from a single year and site and timing of parturition may differ in other years and other areas.

Management

Northern Myotis was listed in 2015 as a Threatened Species under the Endangered Species Act due to impacts of White-Nose Syndrome in eastern North America (U.S. Fish and Wildlife Service 2016). The species is also listed as a Species of Conservation Concern in Montana. The primary reason for both state and federal status is the ongoing catastrophic declines in eastern North America (e.g. Reynolds et al. 2016). Given the species federal status, “take” of the species is prohibited and known hibernacula and maternity roosts receive special protections (U.S. Fish and Wildlife Service 2016).

Aside from White-Nose Syndrome related threats, conservation and management should focus on maintaining ecosystem health and protecting potential active season roosts and hibernacula. Management actions that maintain robust deciduous forests within the species range will ensure high quality roosting habitat. As the species is known to use abandoned mines, closing these mines with a bat friendly gate rather than sealing adits will help maintain access to these features. Protection guidelines and management protocols designated for Townsend's Big-eared Bat (Pierson et al. 1999) are also appropriate for Northern Myotis, especially during winter, and can be used as a default protocol.

Fringed Myotis (*Myotis thysanodes*)

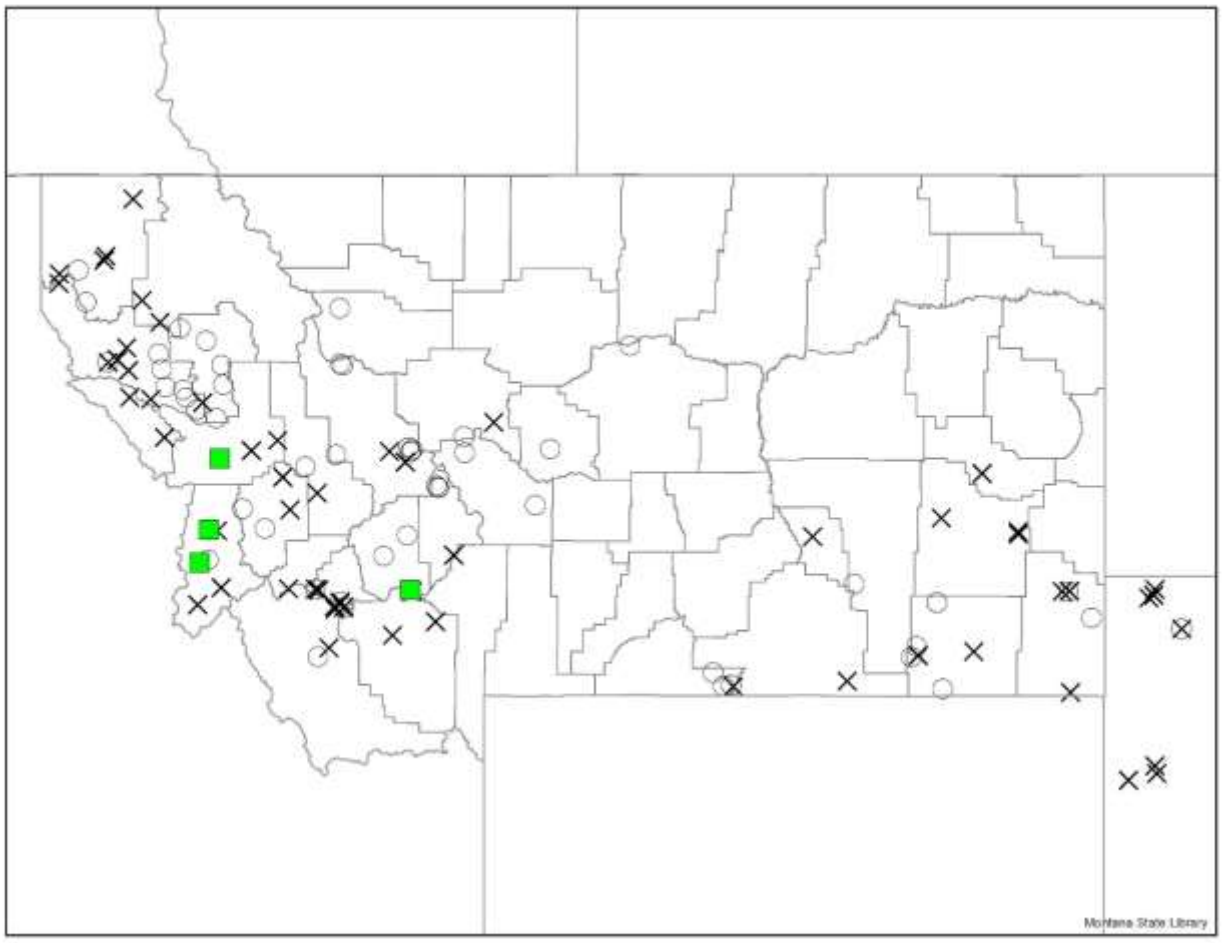

Figure 14. Observations of Fringed Myotis in Montana. Green squares represent voucher specimens, green triangles tissue or guano samples that have been genetically verified. Open circles represent in-hand identifications from mist net captures, roost surveys or incidental encounters. "X"s are hand verified call sequences recorded with acoustic detector/ recorder units.

General Description

Fringed Myotis is Montana's largest Myotis species. It is found in forested areas across the state. Although the species is found across much of the state, detections are relatively rare and it has only been observed 215 times.

Diagnostic Characteristics

The Fringed Myotis is a member of the long-eared *Myotis* group and has ears that are typically longer than 14 mm. Although similar in appearance to Western Long-eared Myotis (*Myotis evotis*), it can be separated from this species by the well-developed fringe of stiff hairs on the posterior margin of the uropatagium. The robust calcar is not distinctly keeled (Bachen et al. 2018). The skull is relatively large, with a well-developed sagittal crest, and 38 teeth (dental formula: I 2/3, C 1/1, P 3/3, M 3/3). Color of the pelage varies from yellowish-brown to darker olivaceous tones; color tends to be darker in northern populations. The ears and membranes are blackish-brown and tend to contrast with the pelage. Length of the head and body is 43 to 59 millimeters, length of the tail is 34 to 45 millimeters, length of the ear is

16 to 20 millimeters, length of the forearm is 40 to 47 millimeters, and weight is 5.4 to 10.0 grams. Females are significantly larger in head, body and forearm size (O'Farrell and Studier 1980, Nagorsen and Brigham 1993, Foresman 2012).

Fringed Myotis can be readily identified in-hand and survey methods like mist netting are efficacious. It can also be detected using acoustic methods as its search phase call sequences can be unique. Genetic identification is currently ineffective for distinguishing this species from Long-eared Myotis.

Distribution

Fringed Myotis has been documented across Montana west of the divide and the central and southern portions of the state to the east. The species has not been captured or recorded in the central portion of this area roughly from a line between Bozeman and Livingston east to Billings. Whether the species is truly absent from this region or just not detected is unknown.

Migration

Migratory movements in Montana have not been studied. Several observations of individuals hibernating in caves have been reported in March. At a cave in the Little Belt Mountains of central Montana, a swarming aggregation was observed in October. Based on these observations it is likely that animals do not make large migration movements, but may move to more suitable features or areas for overwintering. Further study of this is needed.

Habitat

The few Montana records indicate that the habitats in Montana that are used by the Fringed Myotis are similar to other regions in the interior West (Foresman 2012). It has been captured in ponderosa pine and Douglas-fir forest while foraging over willow/cottonwood areas along creeks and over pools, and taken in caves (Lewis and Clark Caverns); one individual was captured in an urban setting in Missoula (Hoffmann et al. 1969, Butts 1993, Dubois 1999).

Habitat information gathered from range-wide studies state the Fringed Myotis is found primarily in desert shrublands, sagebrush-grassland, and woodland habitats. It also occurs at low elevations along the Pacific Coast, and in badlands in the northern Great Plains (Jones et al. 1983, Humes et al. 1999). It roosts in caves, mines, rock crevices, buildings, and other protected sites. Nursery colonies occur in caves, mines, and sometimes buildings (Easterla 1973, O'Farrell and Studier 1980, Jones et al. 1983). Fringed Myotis in riparian areas tend to be more active over intermittent streams with wider channels (5.5 to 10.5 meters) than ones with channels less than 2.0 meters wide (Seidman and Zabel 2001).

Roost Habitat

Hibernating individuals have been observed in caves in Montana, but other hibernacula have not been documented. During the active season one individual was captured emerging from a small crevice in a south facing limestone wall above a cave entrance in the Pryor Mountains (Bachen et al. 2019). In the rest of the species range it is known to use cracks and hollows of larger diameter trees, usually in decay, rock crevices on south-facing slopes, mines, buildings, and bridges (O’Farrell and Studier 1980, Geluso and Mink 2009, Cryan et al. 2001). The species has been reported to be very sensitive to roost disturbance (O’Farrell and Studier 1980).

Food Habits

Food habits have not been studied in the state. Range-wide information state that Fringed Myotis are insectivorous; beetles occurred in 73% and moths in 36% of fecal pellets in New Mexico (Black 1974). The diet in Oregon included over 40% moths, with lesser amounts of five other insect orders and spiders (Verts and Carraway 1998); moths and beetles have been reported in the diet in South Dakota (Turner and Jones 1968).

The diet in Montana has not been reported or studied. The wings of the Fringed Myotis have a high puncture strength, which is characteristic of bats that forage by gleaning from the ground or near thick or thorny vegetation (O'Farrell and Studier 1980); when in flight, Fringed Myotis often forages close to the vegetative canopy.

Ecology

No ecological information is available for the Fringed Myotis in Montana. Across its range, including the Black Hills region, the known activity period of the Fringed Myotis extends from April through September (O'Farrell and Studier 1980, Jones et al. 1983), with hibernation extending from October to April. In Montana the species has not been observed between November and February. Predators of Fringed Myotis are largely unknown; a domestic cat captured a juvenile in Montana (Hoffmann et al. 1969).

Females generally are found at lower elevations than males (Cryan et al. 2000), perhaps because reproductive individuals need warmer roosts in which to raise young. Males and females form separate colonies in summer, although an occasional male may be found in a maternity colony. Sex ratios in trapping samples may be biased because of sex-related differences in habitat use (Bogan et al. 1996). Individuals in an attic complex maternity colony tended to roost in the open in tightly packed clusters. The Fringed Myotis is found with many other bat species (O'Farrell and Studier 1980, Butts 1993, Choate and Anderson 1997, Dubois 1999), including Townsend's Big-eared Bat, Western Long-eared Myotis, Long-legged Myotis, Little Brown Myotis, Yuma Myotis, Western Small-footed Myotis, and California Myotis, each of which is present in Montana.

Reproduction

There is almost no information on reproduction of the Fringed Myotis in Montana. A juvenile was collected in Missoula County in early September, and an adult female in mid-June in Ravalli County, indicating that reproduction occurs in Montana (Hoffmann et al. 1969). Swarming was observed outside of a cave entrance in the Little Belt Mountains in mid-October.

Information gathered from studies in other areas of the species' range indicate apparently little variation in the timing of reproduction throughout the range. In northeastern New Mexico, mating occurs in fall, ovulation, fertilization, and implantation occur from late April to mid-May, gestation lasts 50 to 60 days, and young are born in late June to mid-July. In South Dakota, pregnant females have been captured in mid-June, lactating females in late July through August, and flying young-of-the-year as early as late July or early August (O'Farrell and Studier 1980, Jones et al. 1983, Bogan et al. 1996). The litter size is 1. Young can fly at 16 to 17 days. Maternity colony sizes range up to several hundred individuals. Individuals may live 11 years or more (Paradiso and Greenhall 1967); the record is 18.3 years (Verts and Carraway 1998).

Management

Fringed Myotis is a Montana Species of Conservation Concern. The species is susceptible to White-Nose Syndrome (White-Nose Syndrome Response Team 2020) and this ranks as the largest threat to its persistence and is the primary reason for this status. The impacts of this disease on populations are unknown at this time as there is currently little overlap between the species distribution and areas where the disease is present. Declines driven by moralities at wind turbines is not a concern for this species as no mortalities have been documented in Montana (Poulton and Erickson 2010, Linnell and Smucker 2019), or elsewhere in North America (AWWI 2018).

Although no management measures have been enacted specifically for the protection of Fringed Myotis in Montana, protection of bat roosting habitat through gating of caves and abandoned mines should be beneficial for this species. Protection guidelines and management protocols designated for Townsend's Big-eared Bat (Corynorhinus townsendii) (Pierson et al. 1999) are also appropriate for Fringed Myotis (the two species coexist over much of their ranges) and are recommended as default measures until specific conservation protocols for this species are developed. So little is known about Fringed Myotis in Montana, including its distribution and relative abundance, that standardized surveys of potential roosts and foraging habitats are desirable as the first step to identifying the spatial and temporal context in which this species is present in the state. This basic information will make it easier to design and implement appropriate and effective conservation guidelines to protect important habitats and roosts.

Long-eared Myotis (*Myotis evotis*)

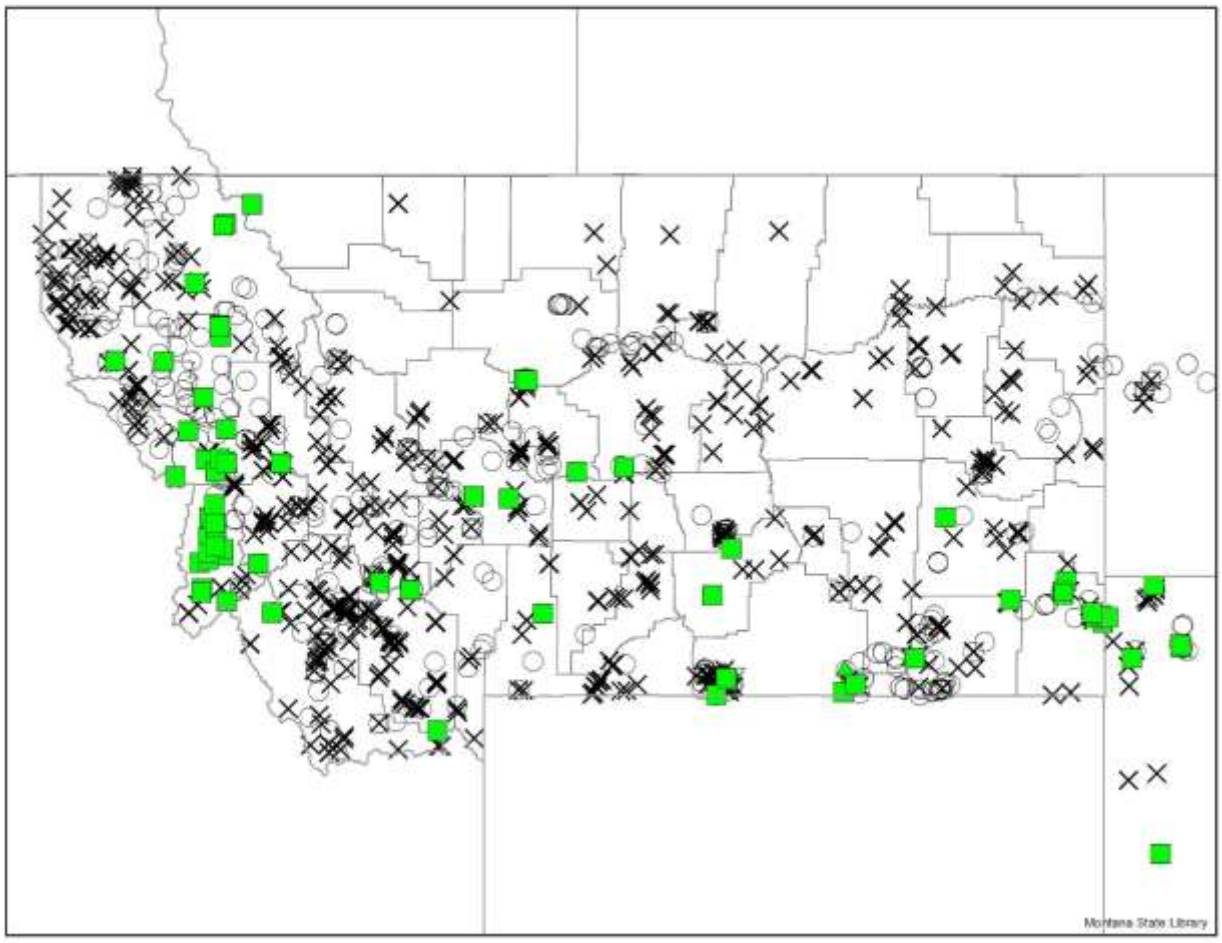

Figure 15. Observations of Long-eared Myotis in Montana. Green squares represent voucher specimens, green triangles tissue or guano samples that have been genetically verified. Open circles represent in-hand identifications from mist net captures, roost surveys or incidental encounters. "X"s are hand verified call sequences recorded with acoustic detector/ recorder units.

General Description

Long-eared Myotis is common and widespread in Montana. As the common name suggests, the species has exceptionally large ears for its size and the longest of any *Myotis* species in the state. The species is flexible in its habitat requirements, but readily used cracks and crevices in rock outcrops and is one of the most frequently detected species in surveys of these features. Across the state the species has been observed 1492 times in all regions.

Diagnostic Characteristics

The exceptionally large ears of this species make it easy to distinguish from most of the other *Myotis* species it co-occurs with. It is most likely to be confused with the Fringed Myotis, and possibly the Northern Myotis where this species is present. Long-eared Myotis is slightly smaller than the Fringed Myotis with proportionally longer ears. Ear lengths of 19mm or greater are a definitive characteristic for Long-eared Myotis. Also Fringed Myotis have prominent stiff hairs on the margin of the uropatagium, which can be used to separate the species. Northern Myotis have brown rather than black skin and

membranes and less contrast between fur and skin color. Also the ears of the Long-eared Myotis will extend 5mm or more beyond the end of the muzzle when gently pushed forward.

Long-eared Myotis can be identified in-hand and roost surveys are an efficient way to survey for the species, particularly surveys of rock outcrops. Deploying mist nets over water and in flyways is also effective for detecting the species. Acoustic methods have been used throughout the species range, and are should be considered to determine presence (Bachen et al. 2018). Unfortunately, genetic methods to determine species identity from guano or tissue samples are not effective for the species at this time as they are unable to differentiate between this and the Fringed Myotis.

Distribution

Long-eared Myotis are found across Montana.

Migration

Long-eared Myotis is a resident species in Montana, although local or regional migration is unstudied. The species has been detected in every month of the year except February, which is similar to other resident *Myotis* species. Across North America, the species is thought to migrate short distances between active season roosts and hibernaculum (Manning and Jones 1989).

Habitat

Habitat for the long-eared Myotis in Montana appears to be defined by the presence of tree or rock outcrop roosts. The species appears to use a broad range of habitat types and is found across a wide range of elevations (Jones et al. 1973). This appears similar to habitats described across the species range (Manning and Jones 1989).

Roost Habitat

During the active season the species has been found roosting in large diameter trees, rock outcrops, buildings, bridges, and in caves (Bell et al. 1962, Hendricks et al. 2000, Schwab 2006, Bachen et al. 2019). Elsewhere in its range, the species also uses manmade structures, mines, crevices, and erosion cavities (Manning and Jones 1989, Waldiien et al. 2000, Rancourt et al. 2005, Nixon et al. 2009). Maternity roosts have been found in caves, rock crevices in cliffs, rock outcrops, and trees and snags (Jones et al. 1976, Schwab 2006, Bachen et al. 2019). Individuals have been found hibernating in caves and mines (Swenson and Shanks 1979, Hendricks 2012, Bachen et al. 2019).

Food Habits

The diet of the Long-eared Myotis has received little study in Montana. Stomach content analysis of 3 specimens from the Ekalaka and Long Pines Hills area of southeast Montana revealed a cicadellid, a chironomid, a small moth (Lepidoptera), a scarab beetle; a dragon fly (*Agrion* spp.); and a large, black bristly muscoid fly (Calliphoridae Diptera) (Jones et al. 1973). Elsewhere the species reportedly consumes: Coleoptera, Diptera, Hemiptera, Homoptera, Hymenoptera, Lepidoptera, and Neuroptera but the species is hypothesized to be a generalist and consume prey related to its availability (Manning and Jones 1989).

Ecology

Little information is available on the ecology of the Long-eared Bat in Montana. The species is generally active from May through September, and observations of active animals during the winter are rare (Bachen et al. 2018).

Reproduction

Females begin to leave hibernacula and travel to maternity roosts in late April or May. Parturition in Montana is thought to begin in late-June based on the capture of flighted juveniles in mid- July. Litter size has not been described in Montana but elsewhere in the species range it is typically one pup (Manning and Jones 1989). Lactating females have been captured as early as the second week of July through mid-August (Bachen et al. 2017). Breeding has not been documented in Montana, but is thought to occur in the fall or winter (Manning and Jones 1989).

Management

Long-eared Myotis has not been assigned a special status by state or federal agencies and no specific management actions are known to be taken on the species behalf. However as White-Nose Syndrome continues to spread across western North America, this may change. Individuals have not been found with symptomatic WNS or detectable *Pd* (White-Nose Syndrome Response Team 2020). However, this is not that surprising as there is little overlap between the species current range and areas where the fungus is present. Impacts of wind energy development are not a concern for this species at this time. Although fatalities have been reported in North America, they are very infrequent (AWWI 2018), and population level impacts seem unlikely.

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